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CONTENTS

CORRECTION

REVIEW, April, 1929:

Page 169, right-hand side, twenty-eighth line from bottom, fourth column opposite Helena, Ark., "41.2" should be "51.2."

MONTHLY WEATHER REVIEW

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VOL. 57, No. 6
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JUNE, 1929

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SOUNDING-BALLOON OBSERVATIONS MADE AT GROESBECK, TEX., DURING THE INTERNATIONAL MONTH, OCTOBER, 1927

By L. T. SAMUELS

[Weather Bureau, Washington, D. C., 1929]

Forty-four sounding balloons were released and 37 (84 per cent) of the instruments were returned. Table 1 is a general summary of the individual observations. In Figure 1 are shown the landing places and corresponding dates. Notwithstanding the predominance of easterly winds to considerable heights nearly all of the balloons landed to the east of Groesbeck. This was due of course to the stronger westerly winds which prevailed at the higher levels. (See figs. 4 and 5.)

It will be noted that in the case of the highest observation (27,671 meters) viz., 6:31 a. m., 15th, the instrument landed only 16 kilometers away as compared with a number of others which did not go so high but landed at considerably greater distances. The balloon released at 4:03 p. m., 18th, landed only 6 kilometers from the station although it reached a height of more than 16 kilometers. In this case the horizontal distance traveled during the ascent alone must have exceeded 34 kilometers, in view of the wind velocity and time the balloon was in the air. The fact that the winds were successively NE., E., SE., S., SW., and W. brought the balloon almost back to its starting point.

It is interesting to note the similarity of the landing places in certain consecutive flights, e. g., those of the 13th, 14th, and 15th.

The average free-lift used was 750 grams. The balloons were made of cut sheet rubber, were 1 meter in diameter and inflated to about 1.5 meters. The Fergusson meteorograph was used.[1]

The weather conditions were exceptionally favorable for long theodolite observations and in practically every case the balloon was followed with two theodolites for a considerable time. In 6 cases this exceeded 100 minutes and in 26 cases it exceeded 60 minutes. In 29 cases, including some of those in which the instrument was not returned but followed with two theodolites, the balloon penetrated the stratosphere.

The average height and temperature of the tropopause as determined from 22 observations are shown in Table 1 and were 14,823 meters and −65.5° C., respectively. These figures for Royal Center for the series made in May, 1926 [2] were 12 kilometers and −58.4° C., indicating as was to be expected, a greater height and lower temperature of the tropopause for the more southern station.

The highest observation was that of 6:31 a. m. of the 15th when an altitude of 27,671 meters was reached.

In Figure 2 is shown the mean temperature curve determined from 24 observations made on as many days during the month, practically all being made in the afternoon. It is interesting to compare with this curve, the one based on the morning kite observations made during the same month. It will be noted that the morning temperatures are lowest from the surface to 3 kilometers but slightly higher than the afternoon temperatures from 4 to 5 kilometers.

The altitude and temperature of the base of the stratosphere for the individual observations are indicated in this figure by dots with the corresponding dates. The extreme range was from 17,467 meters, −78.3° C. at 4:43 p. m. of the 9th to 11,695 meters, −55.6° C. at 6:35 a. m. of the 17th, the temperature, it will be noted, varying inversely as the height of the tropopause. This inverse relationship is well shown in Figure 2. At Royal Center [2] the extreme range in the height of the tropopause was from 14.6 kilometers, −70.9° C. to 8.9 kilometers, −44.5° C., the extreme limits of which, as would be expected, were lower in height. The range in height of the tropopause, it will be noted, was practically the same at both stations, viz., 5.7 kilometers, but the range in the temperature of the tropopause was several degrees greater at Royal Center.

The greatest average lapse rate occurred between 7 and 8 kilometers. (See fig. 2.) This was in identical agreement with the Royal Center observations.[2]

Figure 3 shows the average relative humidity as determined from 12 observations on as many days, the reason for the smaller number as compared with those used for temperature in Figure 2, is that not all of the instruments were equipped with humidity elements and also not all of the humidity records were legible due to the number of rotations of the clock cylinder after the instrument had landed. Neither of these objectionable factors, however, are anticipated in the series planned for December, 1929.

The mean humidity curve determined from 24 morning kite observations has been included in this graph for comparison. Since the balloon data in this figure are based on only half the number of kite observations, agreement of a very high order would not be expected. However, with this difference considered, the general similarity is striking. A prominent feature of this graph

[1] S. P. Fergusson, New Aerological Apparatus, MONTHLY WEATHER REVIEW, June, 1920.

[2] International Aerological Soundings at Royal Center, Ind., May, 1926, MONTHLY WEATHER REVIEW, July, 1927.

is the small variation in relative humidity above 10 kilometers, especially in the stratosphere.

In Figure 4 are shown the wind velocity curves for each day. This series of wind observations is probably the highest ever obtained at one station during a single month. A number of striking features are evident. Foremost of these is the consistent decrease of velocity in the stratosphere. It will be noted that the decrease begins, in general, about 2 kilometers below the average height of the stratosphere. In the 11 observations extending to 17 kilometers or higher the velocity dropped to less than 10 m. p. s. at these upper levels. The highest velocities occur at about 12 or 13 kilometers. The maximum velocity recorded in the entire series was 42.5 m. p. s. at 12 kilometers on the 9th.

In Figure 5 are shown the wind direction curves for each day. Several features are strikingly apparent in this diagram, viz., the wide variation in direction at the surface and lower levels; the veering or backing to westerly at about 12 kilometers, i. e., the same height at which the velocity begins to decrease (see fig. 4); the consistent westerly direction between 12 and 17 kilometers and the shift to easterly above 18 kilometers, i. e., where the velocities have again reached a general minimum.[3]

In Figure 6 are shown the mean wind velocity and direction curves based on the same observations as those shown in figures 4 and 5, i. e., not more than one on the same day and mostly in the afternoon. The mean velocities were determined independently of the directions and therefore these should not be considered together for any particular level.

It will be noted that the average velocity reaches a maximum at 13 kilometers or about 2 kilometers below the average height of the tropopause. (See figs. 2 and 4.) Above 13 kilometers the average velocity decreases at about the same rate at which it increases in the levels below.

The mean wind direction considered without regard to velocity (fig. 6), veers sharply between 1.5 and 2 kilometers from south-southeasterly to northwesterly. A large northerly component persists from 2.5 to 6 kilometers, above which the westerly component predominates to 19 kilometers, where a further veering occurs and an easterly component becomes increasingly predominant.

In Figure 7 are shown the individual temperature curves for the series. The temperatures (° C.) for the surface and maximum altitude are indicated in each case. Isotherms for 0° C., −25° C. and −50° C. have been drawn and show the general character of the fluctuations in temperature at these general elevations. It will be noted that the −50° C. line fluctuates more than the two lower lines which fact is in agreement with other sounding balloon series. The small fluctuation in the 0° C. line is striking. A comparison of Figure 7 with a similar chart drawn for the Royal Center observations[2] shows these three isotherms to be, in general, each about 1 kilometer higher at Groesbeck than at Royal Center.

In Figure 8 are shown the free-air isotherms for the month. It will be noted that the stratosphere was relatively cold between the 9th and 14th and again on the 20th. Sea-level barometric pressure gradients were not pronounced at Groesbeck during the month and there was no apparent connection between the height of the tropopause and the sea-level pressure as is usually found in more northerly latitudes. Likewise, no definite relationship was found between the temperature of the stratosphere and the wind direction, there being very little north or south component between 12 and 17 kilometers. (See fig. 5.)

Table 2 contains the tabulated data for each observation.

For references regarding all previous sounding balloon observations made in the United States, see Table 7 of reference.[2]

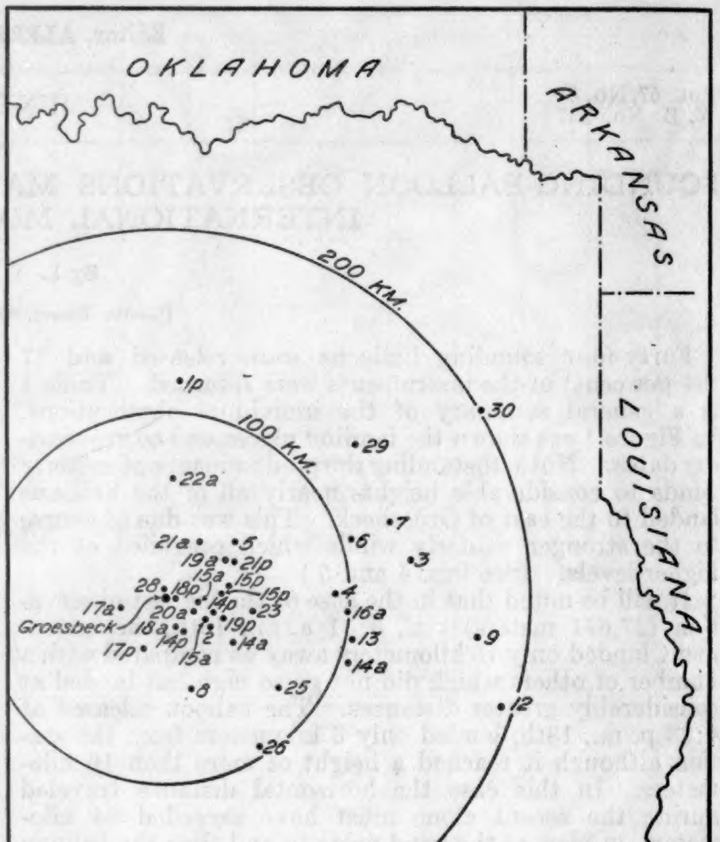

FIGURE 1.—Landing places (with dates) of sounding balloons released from Groesbeck, Tex., during October, 1927

It is expected that these data will be published by the International Commission for the Exploration of the Upper Air, including those for the principal isobaric levels, the latter indicating geo-dynamic meters, instead of geometric heights; also tephigrams.

[3] William R. Blair, The Planetary System of Convection, MONTHLY WEATHER REVIEW, April, 1916.

[2] International Aerological Soundings at Royal Center, Ind., May, 1926, MONTHLY WEATHER REVIEW, July, 1927.

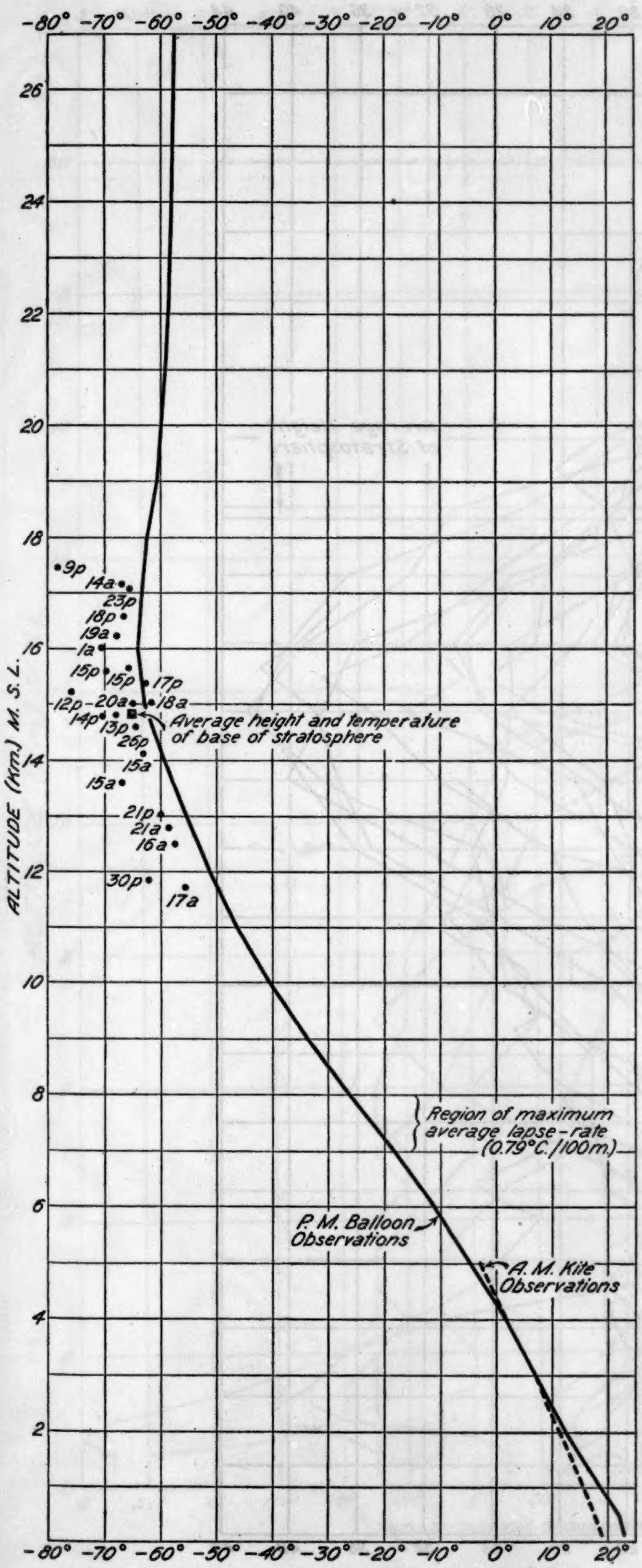

FIGURE 2.—Mean temperature curve (° C.), Groesbeck, Tex., October, 1927

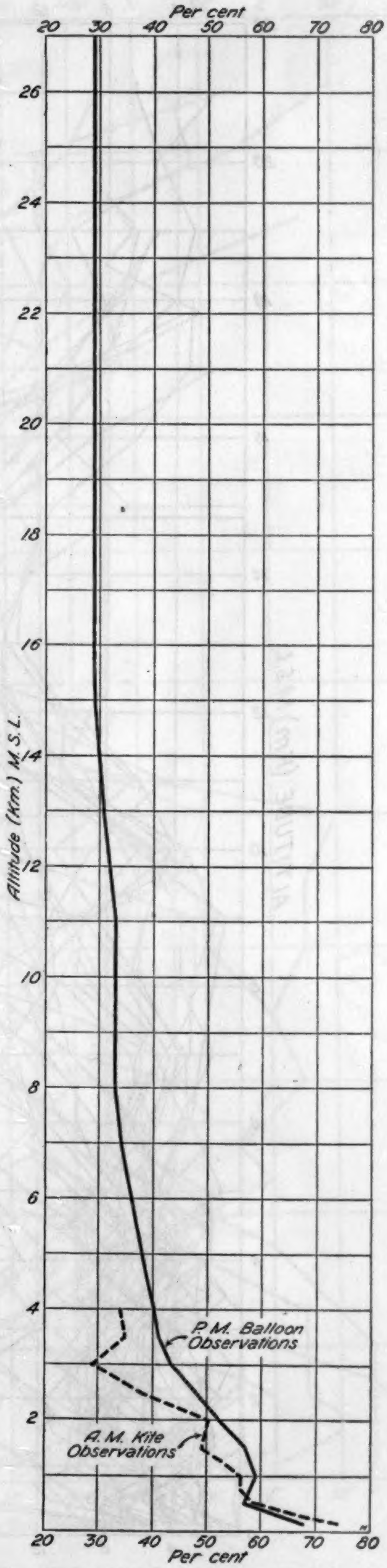

FIGURE 3.—Mean relative humidity curve, Groesbeck, Tex., October, 1927

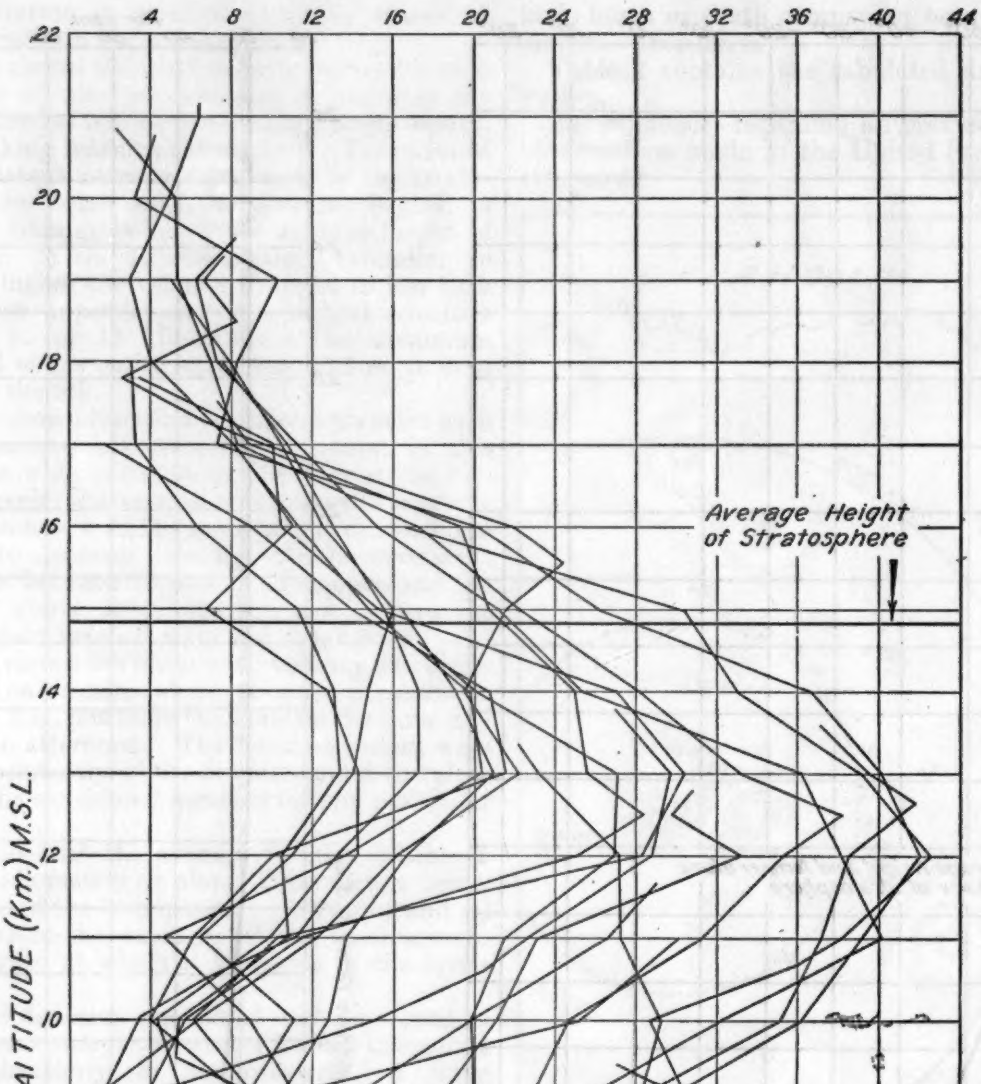

FIGURE 4.—Daily wind velocity curves (m. p. s.), Groesbeck, Tex., October, 1927

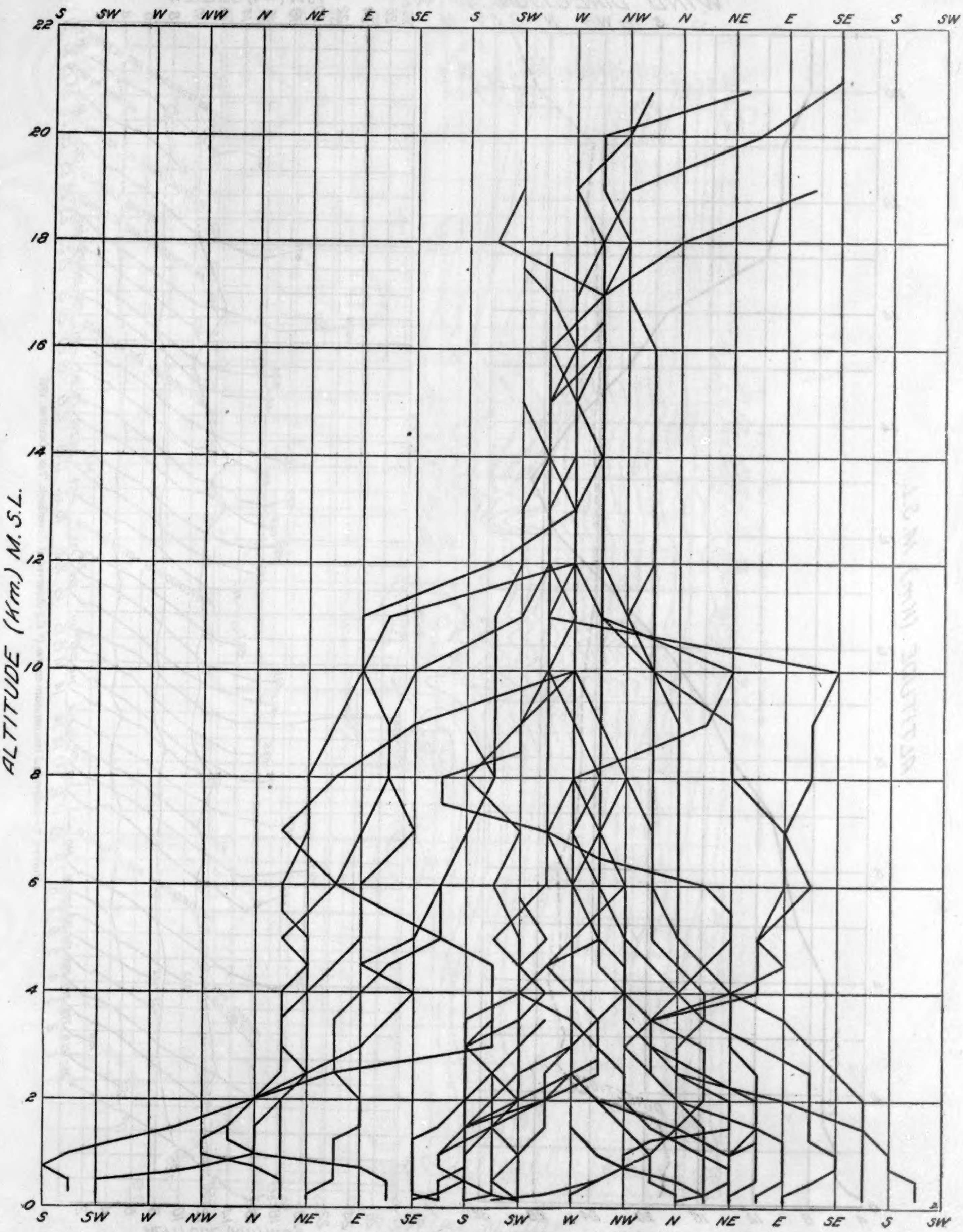

FIGURE 5.—Daily wind direction curves, Groesbeck, Tex., October, 1927

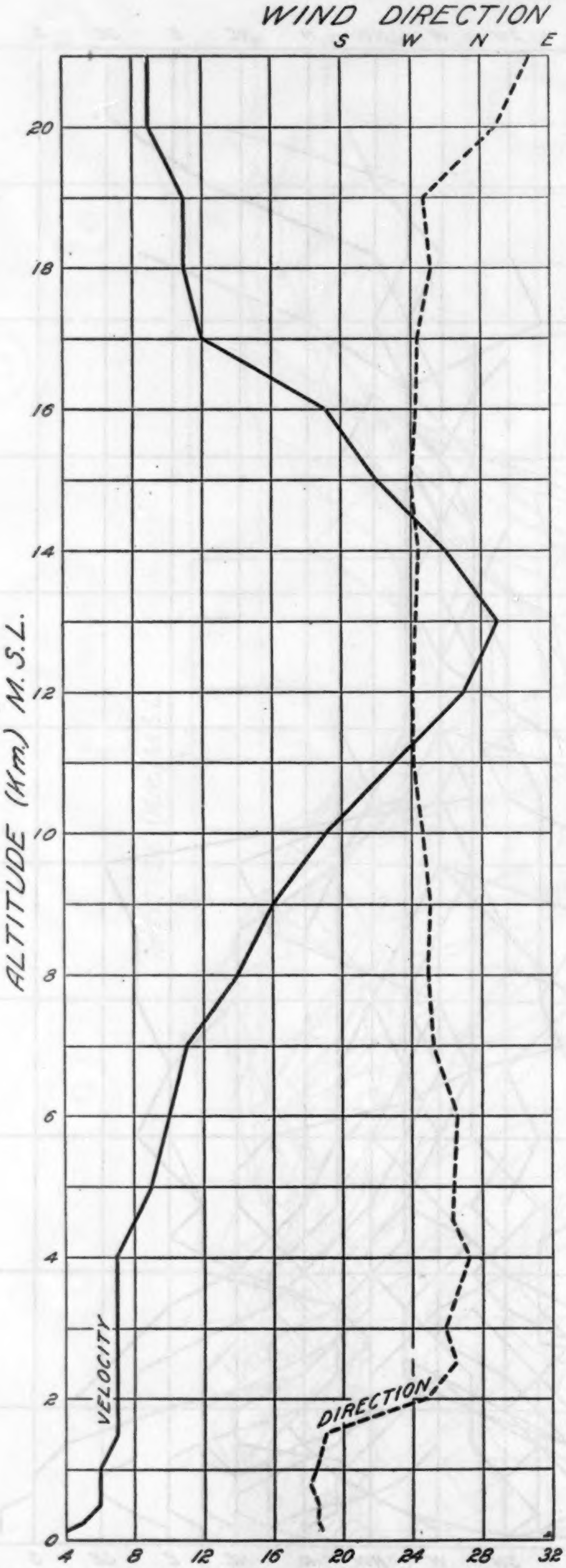

FIGURE 6.—Mean wind velocity (m. p. s.) and direction curves, Groesbeck, Tex., October, 1927

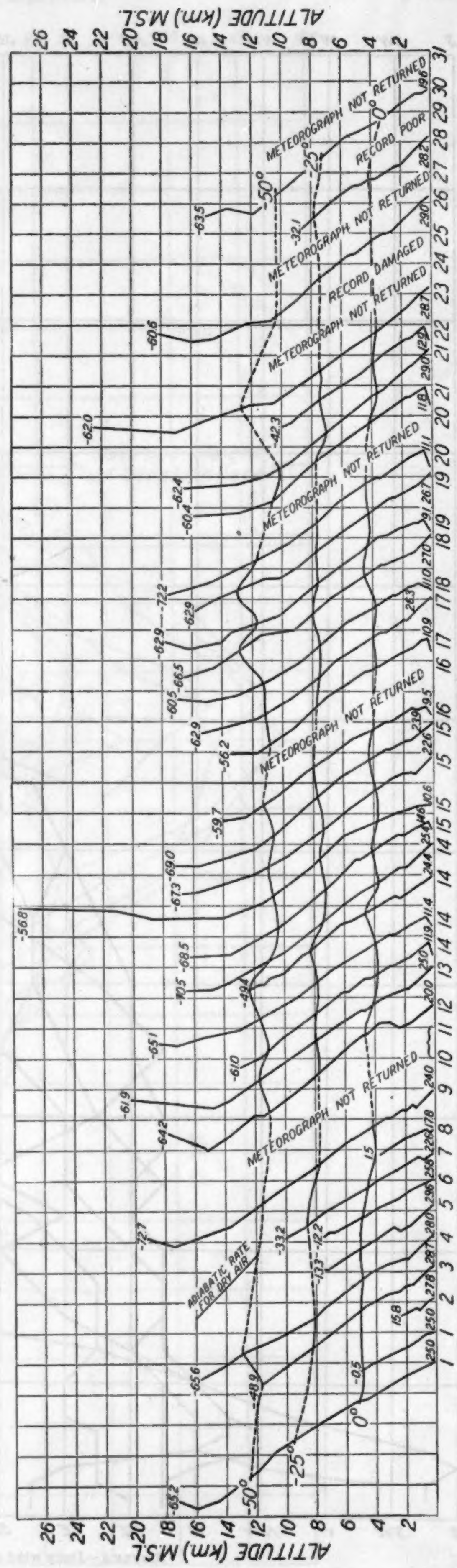

FIGURE 7.—Individual temperature curves (° C.) observed at Groesbeck, Tex., October, 1927

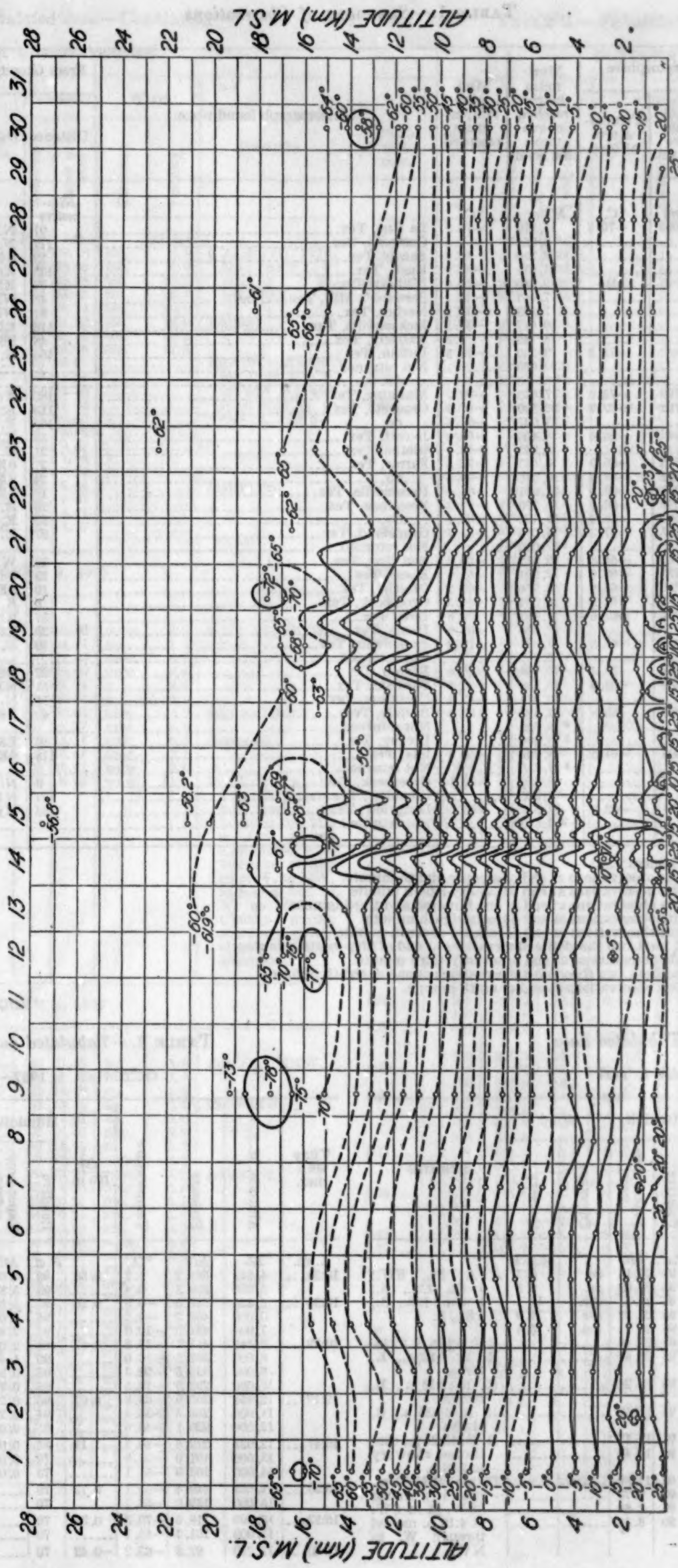

FIGURE 8.—Free-air isotherms (° C.) observed at Groesbeck, Tex., October, 1927

TABLE 1.—*Summary of Observations*

October, 1927	Time of release (ninetieth meridian)	Stratosphere		Maximum height reached above mean sea level	Minimum temperature recorded	Meteorograph found place	From Groesbeck—		Balloons, free-lift	Theodolite observations observed with—	
		Height of base above sea level	Temperature at base				Distance	Direction		1 theodolite	2 theodolites
		Meters	*°C.*	*Meter*	*°C.*		*Kilometers*		*Grams*	*Minutes*	*Minutes*
1	10:10 a.	15,999	−70.3	17,210	−70.3	La Rue, Tex.	97	NE.	962	14	2
1	5:09 p.			5,054	−0.5	Gastonia, Tex.	117	N.	300	8	5
2	4:56 p.			2,350	15.8	Farrar, Tex.	29	SE.	262	42	0
3	5:16 p.			11,619	−48.9	Rusk, Tex.	135	ENE.	558	66	65
4	5:22 p.	(1)	(1)	19,648	−65.6	Elkhart, Tex.	74	ENE.	660	61	61
5	4:48 p.			7,461	−14.1	Steward's Mill, Tex.	48	NE.	457	77	72
6	4:46 p.			7,483	−12.2	Neches, Tex.	97	NE.	307	32	32
7	5:20 p.			10,077	−33.2	Jacksonville, Tex.	116	ENE.	407	2	0
8	5:06 p.			3,744	1.5	Easterly, Tex.	48	SSE.	320	0	0
9	4:43 p.	17,467	−78.3	19,240	−78.3	Lufkin, Tex.	166	E.	730	90	83
10	4:35 p.			[2] 20,620		Not returned			780	79	79
11	4:42 p.			[3] 6,310		do			835	57	24
12	4:54 p.	15,198	−75.6	17,833	−76.7	Manning, Tex.	180	ESE.	630	45	0
13	4:26 p.	14,791	−67.9	20,300	−67.9	Crockett, Tex.	113	E.	662	108	108
14	12:04 a.			13,007	−61.0	do	109	E.	937	15	15
14	6:28 a.	17,165	−66.6	18,406	−66.6	Jewett, Tex.	32	E.	790	64	63
14	12:05 p.			12,243	−49.4	Oletha, Tex.	21	E.	1,187	103	102
14	3:53 p.	14,796	−69.9	16,545	−70.5	Farrar, Tex.	27	SE.	580	97	89
15	12:06 a.	13,591	−67.0	16,316	−68.5	do	24	SE.	997	17	15
15	6:31 a.	14,087	−63.0	27,671	−63.4	Personville, Tex.	16	SE.	1,005	81	75
15	12:11 p.	15,630	−66.1	16,776	−67.3	Freestone, Tex.	29	E.	1,190	65	63
15	4:07 p.	15,563	−69.4	17,150	−69.4	do	32	E.	780	71	69
16	6:33 a.	12,527	−57.3	14,018	−59.7	Grapeland, Tex.	97	E.	970	108	106
16	3:58 p.			[4] 17,052		Not returned			680	111	110
17	6:35 a.	11,695	−55.6	13,512	−56.2	Ben Hur, Tex.	23	WSW.	802	44	35
17	4:15 p.	15,375	−62.9	17,921	−62.9	Kosse, Tex.	29	SSW.	680	123	118
18	6:34 a.	15,017	−62.2	16,976	−62.2	Oleatha, Tex.	19	SE.	995	70	67
18	4:03 p.	16,561	−66.5	16,561	−66.5	Groesbeck, Tex.	6	E.	930	74	67
19	6:34 a.	16,221	−67.6	17,801	−67.6	Dew, Tex.	37	ENE.	950	80	78
19	3:44 p.			15,805	−62.9	Donie, Tex.	29	ESE.	720	70	62
20	6:27 a.	15,033	−64.9	17,631	−72.2	Personville, Tex.	19	E.	970	67	65
20	3:45 p.			[5] 8,890		Not returned			660	52	52
21	6:30 a.	12,833	−58.4	15,908	−60.4	Kirven, Tex.	32	NE.	797	64	63
21	4:04 p.	13,004	−59.9	16,538	−62.4	Fairfield, Tex.	51	NE.	712	63	58
22	6:25 a.			10,014	−42.3	Corsicana, Tex.	71	N.	592	88	83
23	4:31 p.	17,069	−65.8	22,528	−65.8	Buffalo, Tex.	43	ESE.	735	108	163
24	3:59 p.			[6] 19,325		Not returned			850	77	77
25	3:45 p.			[7] 13,490		Dickey, Tex.	89	ESE.	710	100	54
26	3:58 p.	14,603	−64.5	18,202	−66.2	Iola, Tex.	113	SE.	640	97	80
27	3:51 p.			[8] 21,450		Not returned			890	73	73
28	4:03 p.			8,610	−32.1	Groesbeck, Tex.	3	N.	745	33	33
29	4:03 p.			[9] 2,060		Chandler, Tex.	124	NE.	850	8	8
30	3:51 p.	11,853	−62.0	15,019	−63.5	Longview, Tex.	188	NE.	820	0	0
31	3:57 p.			[10] 2,610		Not returned			750	45	9

[1] Temperature record lost above 15,735 meters.
[2] Height determined from two theodolite observations at end of seventy-eighth minute.
[3] Height determined from two theodolite observations at end of twenty-fourth minute.
[4] Height determined from two theodolite observations at end of one hundred and third minute.
[5] Height determined from two theodolite observations at end of forty.eighth minute.
[6] Height determined from two theodolite observations at end of seventy-seventh minute.
[7] (Record damaged) height determined from two theodolite observations at end of fifty-fourth minute.
[8] Height determined from two theodolite observations at end of seventy-third minute.
[9] (Record inaccurate) height determined from two theodolite observations at end of eighth minute.
[10] Height determined from two theodolite observations at end of ninth minute.

TABLE 2.—*Tabulated data*

OCTOBER 1, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	$\frac{\Delta t}{100\text{ m.}}$	Humidity		Wind		Remarks
					Relative	Vapor pressure	Direction	Velocity	
A. m.	*M.*	*Mb.*	*°C.*		*P. ct.*	*Mb.*		*M.p.s.*	
10:10	141	994.2	25.0		92	29.16	se.	6.7	3 A. St., SW.;
	250		24.5		93	28.62	se.	9.3	5 St. Cu., S.;
	500	955.0	23.3		94	26.91	sse.	14.1	1 Cu. Nb., S.;
	750		22.1		95	25.29	sse	15.9	1 St., S.
10:12	771	925.4	22.0	0.48	95	25.14	sse.	16.1	
	1,000	900.8	20.9		95	23.49			R.B.5:18a.,E.5:32a.
	1,250		19.7		95	21.81			R. B. 7:12 a., E. 7:38 a.
	1,500	849.0	18.5		95	20.24			R. B. 9:55 a., E. 10:03 a.
	2,000	802.3	16.2		95	17.50			R. B. 10:53 a., E. 11:30 a.
10:15	2,056	797.2	15.9	0.47	95	17.17			R. B. 12:24 p., continued showery
	2,500	758.9	13.4		94	14.46			to 2:48 p.
	3,000	716.5	10.6		93	11.89			⛈ in S. at 12:20 p.,
	3,500	675.5	7.8		92	9.73			moving from SSW. ⛈ in SW.
	4,000	635.0	4.9		91	7.88			at 4:10 p. moved
	4,500	595.0	2.1		90	6.39			through W. to NW.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 1, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	$\frac{\Delta t}{100\text{ m.}}$	Humidity		Wind		Remarks
					Relative	Vapor pressure	Direction	Velocity	
A. m.	*M.*	*Mb.*	*°C.*		*P. ct.*	*Mb.*		*M.p.s.*	
10:23	4,642	584.2	1.3	0.56	90	6.04			Cloudy throughout day.
	5,000	559.3	0.4		93	5.85			
10:26	5,325	537.0	−0.5	0.26	95	5.57			
	6,000	492.7	−4.3		95	4.07			
	7,000	434.0	−10.0		95	2.49			
10:32	7,382	413.7	−12.2	0.57	95	2.04			
	8,000	382.5	−16.0		95	1.44			
	9,000	335.5	−22.3		95	0.80			
	10,000	292.9	−28.5		95	0.43			
10:40	10,854	258.9	−33.8	0.62	95	0.25			
	11,000	253.5	−35.4		94	0.20			
	12,000	220.1	−46.5		85	0.05			
10:47	12,023	219.6	−46.7	1.11	85	0.05			Superadiabatic.
	13,000	191.0	−53.8		79	0.02			
	14,000	163.9	−61.1		73	0.01			
10:53	14,552	149.4	−65.1	0.73	70				
	15,000	139.0	−66.7		70				
10:57	15,999	118.9	−70.3	0.36	70				Base of stratosphere.
	17,000	101.3	−66.1		70				
11:00	17,210	97.9	−65.2	−0.42	70				

TABLE 2.—*Tabulated data*—Continued

OCTOBER 1, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity		Wind		Remarks
					Relative	Vapor pressure	Direction	Velocity	
P. m.	M.	Mb.	°C.		P.ct.	Mb.		M.p.s.	
5:09	141	990.2	25.0		92	29.16	sse.	4.5	4 A. St., (?); 1 Cu. Nb., SSW.; 4 Nb., S.; 1 St. Cu., SSE.
	250		24.7		90	28.03	sse.	10.9	
	500	951.0	24.0		86	25.68	sse.	18.5	
5:12	737	925.4	23.3	0.28	82	23.48	sse.	20.1	
	750		23.2		82	23.34	sse.	20.0	
	1,000	898.0	21.2		87	21.92	sse.	18.6	Raining.
5:14	1,050	892.8	20.8	0.80	88	21.63	sse.	18.3	
	1,250		19.5		84	19.05	sse.	17.3	
	1,500	848.2	17.9		78	16.01			Intermittent showers from 4:15 p. to 5:35 p.; also from 6:20 p. to Oct. 2, 7:10 a.
5:18	1,851	813.3	15.6	0.65	70	12.41			
	2,000	799.3	14.9		72	12.20			
	2,500	753.2	12.6		77	11.23			
	3,000	709.9	10.3		83	10.40			
	3,500	668.8	7.9		89	9.48			
5:25	3,593	661.0	7.5	0.46	90	9.33			
	4,000	629.5	5.2		90	7.96			
5:28	4,063	624.6	4.8	0.57	90	7.74			
5:29	4,258	609.9	4.6	0.10	90	7.63			Isothermal.
	4,500	592.1	3.0		92	6.97			
	5,000	557.2	−0.2		95	5.71			
5:36	5,054	553.2	−0.5	0.64	95	5.57			

OCTOBER 2, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Relative	Vapor pressure	Direction	Velocity	Remarks
P. m.									
4:56	141	993.2	27.8		67	25.06	wnw.	0.9	1 Ci. St., WSW.; 3 cu, N.
	250		27.1		68	24.41	nw.	1.2	
	500	954.0	25.5		70	22.86	nnw.	0.6	
5:02	664	936.2	24.4	0.65	72	22.02	nnw.	0.8	
	750		23.5		75	21.74	n.	0.9	
	1,000	900.6	20.6		85	20.64	n.	2.9	
5:07	1,139	886.4	19.2	1.10	90	20.03	nnw.	4.2	Superadiabatic.
	1,250		20.7		67	16.37	nnw.	6.2	
5:09	1,285	871.4	21.2	−13.7	60	15.11	nnw.	6.5	Inversion.
	1,500	850.3	20.1		58	13.65	nnw.	7.1	
	2,000	802.6	17.6		53	10.67	wnw.	9.0	
5:31	2,350	770.0	15.8	0.51	50	8.98	wnw.	11.2	R. B. 8:01 a., E. 9 a. Total rainfall during 24 hours ending 7:10 a, Oct. 2 was 8.86 inches. Surface wind shifted from W. to NW. at 8:35 a. and to N. at 10:15 a. Cloudy during morning; partly cloudy during afternoon.

OCTOBER 3, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Relative	Vapor pressure	Direction	Velocity	Remarks
P. m.									
5:16	141	998.0	28.7		55	21.68	n.	1.8	Few Cu., NNW.
	250		28.4		54	20.91	nne.	1.7	
5:18	402	969.0	27.2	0.57	52	18.78	ne.	1.8	
	500	958.3	26.3		54	18.50	ne.	2.0	Clear all day.
	750		23.9		58	17.21	ne.	2.6	
	1,000	905.3	21.6		62	16.01	nne.	2.9	
	1,250		19.2		66	14.69	n.	3.7	
	1,500	854.3	16.9		70	13.48	nnw.	4.7	
5:24	1,528	851.6	16.6	0.94	70	13.23	nnw.	4.8	Adiabatic.
	2,000	805.4	15.3		43	7.48	nw.	5.3	
5:26	2,062	799.8	15.1	0.28	40	6.87	nw.	5.1	
5:28	2,431	765.5	12.1	0.81	44	6.21	nw.	5.5	
	2,500	759.3	11.9		43	5.99	nw.	5.7	
	3,000	715.1	10.6		34	4.35	wnw.	5.6	
5:32	3,221	696.5	10.0	0.27	30	3.68	wsw.	2.8	
	3,500	673.7	8.5		29	3.22	wnw.	1.6	
	4,000	634.0	5.9		26	2.41	nnw.	6.0	
	4,500	596.1	3.2		23	1.77	wnw.	7.3	
5:40	4,731	579.6	2.0	0.53	22	1.55	wnw.	7.7	
	5,000	560.4	−0.1		22	1.33	wnw.	8.0	
	6,000	494.1	−8.0		22	0.69	w.	11.3	
5:49	6,328	474.1	−10.6	0.79	22	0.55	w.	11.2	
	7,000	435.2	−15.6		21	0.33	w.	14.0	
	8,000	381.0	−23.0		20	0.16	w.	11.3	
5:59	8,218	369.5	−24.6	0.74	20	0.13	w.	11.4	
	9,000	340.3	−30.2		20	0.08	w.	13.5	
	10,000	293.9	−37.4		20	0.03	wsw.	19.7	
6:11	10,282	277.4	−39.4	0.72	20	0.03	wsw.	22.4	
	11,000	252.1	−44.5		20	0.01	wsw.	25.4	
6:23	11,619	228.5	−48.9	0.71	20	0.01			

TABLE 2.—*Tabulated data*—Continued

OCTOBER 4, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity		Wind		Remarks
					Relative	Vapor pressure	Direction	Velocity	
P. m.	M.	Mb.	°C.		P.ct.	Mb.		M.p.s.	
5:22	141	998.6	28.0		48	18.16	sse.	2.2	Cloudless.
	250		28.3		41	15.78	se.	4.0	Clear all day.
5:22½	265	984.6	28.3	−0.24	40	15.40	se.	4.1	Inversion.
	500	959.0	26.1		42	14.21	se.	5.2	
	750		23.8		44	12.98	se.	5.6	
5:25	860	920.3	22.8	0.92	45	12.50	se.	5.6	Adiabatic.
	1,000	905.5	21.5		45	11.55	se.	5.7	
	1,250		19.1		44	9.73	se.	5.8	
	1,500	854.4	16.7		43	8.18	sse.	6.0	
5:30	1,954	809.8	12.3	0.96	42	6.01	s.	5.4	Adiabatic.
	2,000	805.3	12.8		42	6.21	s.	5.4	
5:31	2,061	799.7	13.4	−1.03	42	6.46	s.	5.3	Inversion.
	2,500	759.5	12.0		34	4.77	ssw.	5.1	
	3,000	715.3	10.4		25	3.15	s.	4.0	
5:36	3,283	691.0	9.5	0.32	20	2.37	sw.	3.8	
	3,500	673.0	8.4		19	2.09	sw.	5.3	
	4,000	632.9	5.9		17	1.58	sw.	6.6	
5:40	4.312	609.8	4.4	0.50	16	1.34	sw.	5.1	
	4,500	595.4	3.0		16	1.21	sw.	4.8	
	5,000	559.7	−0.6		16	0.93	sw.	4.5	
5:49	5,988	494.9	−7.8	0.73	16	0.51	ssw.	6.5	
	6,000	494.0	−7.9		16	0.50	ssw.	6.4	
	7,000	434.9	−15.4		15	0.24	sw.	4.4	
5:55	7,502	406.3	−19.1	0.75	15	0.17	s.	3.2	
	8,000	380.0	−24.3		15	0.10	s.	2.6	
5:59	8,157	371.8	−25.9	1.04	15	0.09	s.	2.6	Superadiabatic.
	9,000	331.0	−30.4		15	0.06	sw.	2.8	
	10,000	287.5	−35.8		14	0.03	w.	15.0	
6:06	10,635	263.0	−39.2	0.54	14	0.02	w.	20.3	
	11,000	249.9	−40.7		14	0.02	w.	22.5	
	12,000	216.8	−44.8		13	0.01	w.	28.6	
6:14	12,801	192.2	−48.1	0.41	13	0.01	w.	29.4	
	13,000	186.9	−49.4		13	0.01	w.	29.6	
	14,000	160.4	−55.9		15		wnw.	26.0	
6:24	14,313	153.0	−58.0	0.65	15				
	15,000	138.0	−61.7		15				
6:29	[1] 15,735	122.6	−65.6	0.53	15				
	16,000	117.9			15				
	17,000	101.9			15				
	18,000	87.6			15				
	19,000	74.2			15				
	19,648	65.6			15				

OCTOBER 5, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Relative	Vapor pressure	Direction	Velocity	Remarks
P. m.									
4:48	141	997.3	29.6		50	24.49	s.	4.0	1 Cu., SSW.
	250		28.6		61	23.90	sse.	4.6	
	500	958.1	26.2		64	21.79	sse.	5.8	Cloudy in morning; clear in afternoon.
	750		23.9		68	20.18	s.	6.9	
	1,000	904.7	21.5		71	18.22	s.	7.5	
	1,250		19.2		75	16.70	ssw.	7.1	
4:53	1,266	877.2	19.0	0.94	75	16.48	ssw.	7.0	Adiabatic.
	1,500	852.9	16.9		83	15.99	ssw.	6.8	
4:56	1,698	834.0	15.2	0.88	90	15.55	ssw.	7.6	10/10 Lt. fog B. DN a., E. 9:35 a.
	2,000	805.3	13.6		86	13.40	sw.	6.8	Sprinkle B. 10 a., E. 10:05 a.
4:59	2,375	770.1	11.6	0.53	80	10.93	sw.	5.9	
	2,500	758.9	12.3		64	9.16	sw.	5.4	
5:02	2,817	730.3	14.1	−0.57	25	4.02	ssw.	4.6	Inversion.
	3,000	714.9	11.9		24	3.34	s.	5.0	
	3,500	673.8	9.5		21	2.49	s.	3.9	
	4,000	634.3	6.1		19	1.79	sw.	4.0	
5:11	4,168	621.1	5.0	0.67	18	1.57	wsw.	4.7	
	4,500	596.9	3.1		18	1.37	sw.	7.0	
	5,000	560.8	0.2		17	1.05	sw.	6.1	
5:24	5,672	515.6	−3.7	0.58	16	0.72	wsw.	7.0	
	6,000	495.0	−5.8		16	0.60	wsw.	10.0	
	7,000	435.9	−12.2		14	0.30	wsw.	11.1	
5:45	7,293	419.1	−14.1	0.64	14	0.25			
5:50	7,461	409.9	−13.3	−0.48	14	0.27			Inversion.

OCTOBER 6, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Relative	Vapor pressure	Direction	Velocity	Remarks
P. m.									
4:46	141	997.3	25.8		88	29.26	se.	3.1	2 A. St., SSW.; 5 Cu., WSW.
	250		25.1				sse.	6.4	
	500	957.6	23.7				sse.	11.2	Cloudy in morning; partly cloudy in afternoon.
4:49	745	930.9	22.2	0.60			s.	12.2	
	1,000	904.0	21.1				s.	9.7	
	1,250		20.1				s.	8.6	Lt. rain from 9:15 a. to 10 a. about 10 mi. S. of station.
	1,500	853.4	19.1				s.	7.4	

[1] Temperature record lost above 15,735 m.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 6, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P.ct.	Mb.		M.p.s.	
4:55	1,712	832.4	18.2	0.41			s.	8.0	R. B. 1:44 p., E. 2 p. ☈ in S. at 2:30 p. R. B. 3:45 p., E. 4 p. (thunder-squall).
	2,000	805.0	16.2				ssw.	7.4	
	2,500	759.1	12.8				ssw.	7.0	
5:00	2,540	755.3	12.5	0.69			ssw.	7.0	
	3,000	714.5	10.5				sw.	8.2	
	3,500	672.6	8.3				sw.	8.9	
5:08	3,847	645.7	6.8	0.44			sw.	9.0	
	4,000	633.8	5.9				sw.	8.4	
	4,500	597.0	2.8				sw.	8.8	
5:13	4,780	576.5	1.1	0.61			sw.	8.0	
	5,000	560.9	0.0				wsw.	8.3	
	6,000	494.6	−5.2						
5:23	6,771	448.5	−9.2	0.52					
	7,000	435.5	−9.2						
5:25	7,144	427.4	−9.2	0.00					Isothermal.
5:28	7,483	409.5	−12.2	0.88					

OCTOBER 7, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
5:20	141	999.3	22.6		89	24.42	nne.	5.4	3 St. Cu.; NE.; 7 St., NNE.
	250		21.9		89	23.41			
	500	959.2	20.3		90	21.45			
	750		18.6		90	19.30			Cloudy all day.
5:23	801	925.9	18.3	0.65	90	18.94			
	1,000	905.0	19.4		83	18.71			
5:25	1,133	890.9	20.1	−0.54	78	18.36			Inversion.
	1,250		19.4		79	17.81			
	1,500	853.4	18.0		80	16.52			Intermittent showers from 9 a. to 2:50 p. and from 5:40 p. to Oct. 8, 7:05 a.
	2,000	805.0	15.0		82	13.99			
	2,500	759.7	12.0		85	11.93			
5:34	2,592	750.9	11.6	0.58	85	11.61			Surface wind shifted about 11:45 a. from SW. to N.
	3,000	717.0	9.4		85	10.02			
	3,500	675.0	6.8		85	8.40			
5:40	3,877	643.2	4.8	0.53	85	7.31			
	4,000	634.0	3.9		85	6.86			
	4,500	596.0	0.3		86	5.37			
5:47	4,682	582.5	−1.0	0.72	86	4.84			
	5,000	559.5	−2.7		86	4.21			
	6,000	492.9	−7.8		85	2.69			
5:59	6,184	481.6	−8.8	0.52	85	2.47			
	7,000	433.9	−13.4						
6:08	7,448	408.9	−15.9	0.56					
	8,000	379.3	−20.2						
6:19	8,740	343.7	−26.0	0.78					
	9,000	332.0	−27.4						
	10,000	290.0	−32.8						
6:41	10,077	286.5	−33.2	0.54					

OCTOBER 8, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
5:06	141	999.7	17.8		95	19.37	nne.	4.5	10 St., NNE.
	250		16.8						
5:09	364	973.9	15.7	0.94					Adiabatic.
	500	958.5	16.8						
5:12	620	945.2	17.8	−0.82					Inversion.
	750		17.2						
	1,000	904.3	16.2						Cloudy all day.
5:26	1,161	887.1	15.5	0.43					
	1,250		15.2						Intermittent rain from 9:05 a. to 10:30 a. R. B. 3:26 p., E. 5:30 p.
	1,500	852.0	14.2						
	2,000	803.0	12.3						
5:30	2,045	798.9	12.1	0.38					
	2,500	756.0	9.2						
	3,000	712.0	6.1						
5:57	3,127	701.2	5.3	0.63					
	3,500	670.2	3.0						
6:11	3,744	650.2	1.5	0.62					

OCTOBER 9, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
4:43	141	999.7	24.0		46	13.74	ne.	3.1	Few Ci, W.
	250		22.9				ne.	3.6	
	500	958.5	20.8				ne.	4.5	Cloudy to 10 a., then clear in afternoon.
	750		18.6				ne.	5.0	
	1,000	905.0	16.4				ne.	5.2	
	1,250		14.2				ene.	5.2	
4:47	1,278	875.7	12.6	1.00			ene.	5.2	Adiabatic.
	1,500	852.3	14.2				ene.	4.3	
4:48	1,532	849.5	14.4	−0.71			ene.	4.1	Inversion.
4:50	1,956	807.8	10.5	0.92			n.	1.5	Adiabatic.
	2,000	803.4	10.7				n.	1.4	
4:51	2,190	785.5	11.3	−0.34			nnw.	1.1	Inversion.
	2,500	756.7	9.0				nnw.	0.6	
4:54	2,948	716.8	5.7	0.74			nw.	2.0	
	3,000	712.1	5.7				nw.	2.1	

TABLE 2.—*Tabulated data*—Continued

OCTOBER 9, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P.ct.	Mb.		M.p.s.	
4:55	3,265	689.6	5.7	0.00			nnw.	2.5	Isothermal.
	3,500	669.9	4.3				nnw.	2.9	
	4,000	629.5	1.3				nw.	4.8	Misting B. DNa., E. 7. 7:03 a.
	4,500	591.5	−1.8				nw.	7.6	Misting B. 7:45 a., E. 8:45 a.
	5,000	555.1	−4.8				wnw.	9.8	
5:06	5,529	519.5	−8.0	0.60			w.	11.5	
5:07	5,555	517.9	−7.7	−1.15			w.	11.6	Inversion.
	6,000	489.4	−11.0				w.	12.0	
5:12	6,585	453.2	−15.4	0.75			w.	15.6	
	7,000	430.4	−18.6				wnw.	21.0	
	8,000	375.9	−26.3				wnw.	27.4	
5:21	8,314	359.2	−28.7	0.77			wnw.	33.0	
	9,000	325.0	−33.0				w.	30.6	
	10,000	282.3	−39.3				w.	28.6	
5:31	10,675	257.0	−43.6	0.63			w.	35.8	
	11,000	245.4	−45.9				w.	38.0	
	12,000	212.0	−53.0				w.	42.5	
	13,000	182.3	−60.0				w.	37.0	
5:46	13,807	159.7	−65.7	0.71			w.	31.6	
	14,000	155.7	−66.4				w.	32.8	
	15,000	134.0	−69.8				w.	30.0	
	16,000	113.0	−73.2				w.	16.5	
	17,000	95.0	−76.7						
6:01	17,467	87.8	−78.3	0.34					Base of stratosphere.
	18,000	80.5	−76.6						
	19,000	68.5	−73.5						
6:10	19,240	65.4	−72.7	−0.32					

OCTOBER 12, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
4:54	141	1,002.4	20.0		37	8.66	n.	7.6	Cloudless all day.
	250		19.0				nne.	7.0	
	500	961.1	16.8				nne.	7.3	
4:56	629	946.8	15.7	0.88			nne.	8.4	
	750		14.8				nne.	9.7	
	1,000	905.7	12.9				nne.	11.5	
	1,250		10.9				nne.	12.4	
	1,500	853.2	9.1				nne.	14.8	
5:00	1,611	842.0	8.2	0.76			n.	15.8	
	2,000	803.2	6.5				n.	19.0	
5:03	2,379	767.2	4.8	0.44			nnw.	16.9	
	2,500	755.9	5.6				nnw.	16.8	
5:06	2,958	715.0	8.4	−0.62			nnw.	20.2	Inversion.
	3,000	711.4	8.4				nnw.	20.3	
	3,500	670.0	8.3				nw.	21.0	
5:10	3,741	650.5	8.2	0.03			nw.	19.0	Isothermal.
	4,000	630.6	6.0				nw.	18.1	
	4,500	593.1	1.8				nw.	17.8	
5:14	4,680	579.9	0.3	0.84			nw.	19.4	
5:16	4,830	569.0	0.1	0.13			nw.	20.0	
	5,000	556.9	−1.3				nw.	20.2	
5:20	5,743	506.9	−7.2	0.80			nw.	20.0	
	6,000	490.7	−9.5				nw.	19.1	
5:26	6,909	435.6	−17.5	0.88			nw.	25.0	
	7,000	430.6	−18.3				wnw.	25.1	
	8,000	376.6	−27.0				wnw.	26.3	
5:35	8,657	343.5	−32.7	0.87			wnw.	28.7	
	9,000	327.9	−35.2				wnw.	30.9	
	10,000	283.6	−42.4						
5:44	10,659	257.8	−47.2	0.72					
	11,000	245.2	−49.5						
5:48	11,403	230.7	−52.2	0.67					
5:51	11,985	211.4	−52.4	0.03					Isothermal.
	12,000	211.0	−52.5						
	13,000	180.5	−60.3						
6:00	13,705	162.0	−65.8	0.78					
	14,000	154.9	−67.8						
	15,000	131.9	−74.5						
6:12	15,198	127.1	−75.6	0.66					Base of stratosphere.
6:17	15,369	123.6	−73.8	−1.05					
6:21	15,916	113.0	−76.7	0.53					
	16,000	111.5	−76.2						
	17,000	96.0	−69.6						
6:46	17,833	82.7	−64.2	−0.65					

OCTOBER 13, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
4:26	141	1,005.1	25.0		28	8.88	n.	2.7	Cloudless all day.
	250		24.0		28	8.36	n.	3.4	
	500	964.3	21.8		28	7.32	nnw.	4.3	
	750		19.5		28	6.35	nnw.	4.4	
	1,000	909.8	17.2		28	5.50	n.	4.2	
4:31	1,171	891.9	15.7	0.90	28	5.00	nnw.	4.8	Adiabatic.
	1,250		15.0		29	4.95	nnw.	5.0	
	1,500	858.0	12.9		30	4.46	nnw.	5.5	
4:33	1,783	829.3	10.5	0.85	32	4.06	n.	6.9	
4:34	1,995	808.3	10.3	0.09	30	3.76	n.	9.8	Isothermal.
	2,500	761.0	8.4		34	3.75	n.	12.0	

TABLE 2.—*Tabulated data*—Continued

OCTOBER 13, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P. ct.	Mb.		M. p. s.	
4:40	2,971	718.7	6.6	0.38	37	3.60	n.	10.6	
	3,000	716.0	6.5	------	37	3.58	nnw.	11.0	
	3,500	673.6	4.2	------	38	3.14	nw.	12.8	
4:43	3,681	658.9	3.4	0.45	38	2.96	nw.	14.8	
	4,000	633.3	1.1	------	38	2.51	nw.	15.6	
	4,500	595.1	−2.5	------	38	1.89	nw.	12.2	
4:48	4,677	582.1	−3.8	0.72	38	1.69	nw.	13.4	
4:49	4,924	564.1	−3.3	−0.20	35	1.63	wnw.	14.8	Inversion.
	5,000	559.0	−3.8	------	34	1.52	wnw.	14.6	
	6,000	492.4	−10.2	------	27	0.69	wnw.	16.2	
4:55	6,343	470.4	−12.4	0.64	25	0.53	wnw.	12.7	
	7,000	431.6	−16.9	------	23	0.32	wnw.	15.8	
5:03	[1] 7,813	387.1	−22.5	0.69	20	0.16	wnw.	20.4	
	8,000	377.5	−23.8	------	20	0.14	wnw.	20.4	
	9,000	329.0	−30.6	------	20	0.07	w.	26.0	
	10,000	286.3	−37.5	------	20	0.03	w.	24.0	
	11,000	248.0	−44.3	------	20	0.02	w.	14.2	
	12,000	213.7	−51.2	------	20	0.01	wnw.	15.9	
	13,000	183.2	−58.0	------	20	------	w.	18.0	
5:37	13,726	163.9	−62.9	0.68	20	------	w.	12.5	
	14,000	156.9	−64.2	------	19	------	w.	14.0	
5:43	14,791	138.6	−67.9	0.47	18	------	wsw.	14.1	Base of stratosphere.
	15,000	134.2	−67.7	------	18	------	wsw.	14.4	
	16,000	114.2	−66.6	------	18	------	w.	16.7	
	17,000	97.3	−65.5	------	18	------	w.	8.0	
	18,000	83.1	−64.4	------	18	------	nw.	5.2	
	19,000	70.8	−63.3	------	18	------	w.	4.2	
	20,000	60.3	−62.2	------	18	------	nw.	5.1	
6:14	20,300	57.7	−61.9	−0.11	18	------	nw.	11.2	

OCTOBER 14, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
12:04	141	1,006.4	11.9	------	89	12.40	w.	2.7	Cloudless all day.
	250	------	16.3	------	67	12.42	wnw.	2.1	
12:05	370	979.6	20.8	−3.89	44	10.82	nw.	1.5	Inversion.
	500	965.0	19.8	------	44	10.17	n.	1.8	
	750	------	17.9	------	44	9.03	nne.	3.6	
	1,000	909.9	16.0	------	44	8.00	n.	4.1	
	1,250	------	14.1	------	44	7.08	nnw.	4.8	
	1,500	857.9	12.2	------	44	6.25	nnw.	5.8	
12:09	1,581	849.6	11.6	0.76	44	6.01	nnw.	6.3	
	2,000	808.0	9.4	------	43	5.07	nnw.	8.4	
	2,500	761.0	6.7	------	41	4.02	nne.	11.7	
12:13	2,771	736.0	5.3	0.53	40	3.56	nne.	10.5	
	3,000	715.5	5.0	------	38	3.31	nne.	9.2	
12:14	3,025	713.2	5.0	0.12	38	3.31	nne.	9.1	
	3,500	673.0	2.2	------	38	2.72	n.	9.3	
	4,000	632.0	−0.8	------	37	2.12	nnw.	6.9	
12:19	4,218	615.3	−2.1	0.59	37	1.90	------	------	
	4,500	594.0	−2.5	------	36	1.79	------	------	
12:20	4,722	577.7	−2.9	0.16	36	1.73	------	------	
	5,000	558.0	−5.2	------	35	1.39	------	------	
12:25	5,746	507.0	−11.2	0.81	32	0.75	------	------	
	6,000	491.0	−11.5	------	31	0.71	------	------	
12:26	6,145	481.5	−11.7	0.13	30	0.68	------	------	
	7,000	430.3	−18.5	------	29	0.35	------	------	
12:34	7,876	382.4	−25.4	0.79	28	0.17	------	------	
	8,000	376.0	−26.3	------	28	0.16	------	------	
	9,000	328.0	−33.5	------	28	0.07	------	------	
	10,000	284.1	−40.7	------	28	0.03	------	------	
12:43	10,166	277.3	−41.9	0.72	28	0.03	------	------	
	11,000	245.3	−49.5	------	27	0.01	------	------	
12:53	11,548	225.9	−54.1	0.88	26	0.01	------	------	
	12,000	211.0	−56.3	------	26	------	------	------	
	13,000	180.8	−61.0	------	26	------	------	------	
1:01	13,007	180.6	−61.0	0.47	26	------	------	------	

OCTOBER 14, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
6:28	141	1,007.8	11.4	------	75	10.11	ese.	2.2	Cloudless all day.
	250	------	13.1	------	64	9.65	ese.	4.2	
	500	965.6	16.9	------	40	7.70	ese.	5.4	
6:29	553	959.9	17.7	−1.53	35	7.09	e.	4.5	Inversion.
	750	------	16.7	------	35	6.66	ene.	2.0	
	1,000	910.4	15.4	------	35	6.12	n.	1.6	
	1,250	------	14.1	------	34	5.47	n.	2.8	
	1,500	858.1	12.9	------	34	5.06	n.	4.6	
6:33	1,786	829.7	11.4	0.51	34	4.58	n.	6.5	
	2,000	808.2	10.0	------	33	4.05	nne.	8.4	
	2,500	761.0	6.9	------	32	3.18	nne.	10.3	
6:37	2,642	747.9	6.1	0.63	32	3.01	nne.	9.5	
	3,000	715.8	6.0	------	32	2.99	nne.	6.2	
6:38	3,011	714.8	6.0	0.03	32	2.99	nne.	6.2	Isothermal.
	3,500	672.0	3.0	------	31	2.35	ne.	7.0	
	4,000	631.0	0.0	------	31	1.89	ne.	7.2	
	4,500	593.8	−3.0	------	30	1.43	nne.	4.6	

[1] Altitudes above this obtained from 2 theodolite observations; pressures computed.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 14, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.	M.	Mb.	°C.		P. ct.	Mb.		M. p. s.	
6:43	4,643	583.9	−3.9	0.61	30	1.33	nne.	4.0	
	5,000	559.5	−6.1	------	30	1.10	n.	4.0	
	6,000	493.0	−12.1	------	29	0.63	ne.	5.8	
6:50	6,849	439.0	−17.2	0.60	28	0.38	ne.	5.3	
	7,000	430.1	−18.4	------	28	0.34	ne.	4.6	
	8,000	375.1	−26.1	------	28	0.16	nne.	6.6	
	9,000	327.0	−33.9	------	28	0.07	n.	5.0	
6:58	9,038	325.5	−34.2	0.78	28	0.07	n.	5.0	
	10,000	284.0	−39.9	------	28	0.04	nw.	10.0	
7:04	10,462	265.9	−42.7	0.60	28	0.03	wnw.	14.9	
	11,000	245.6	−45.6	------	28	0.02	------	------	
	12,000	211.1	−51.0	------	28	0.01	------	------	
	13,000	181.9	−56.4	------	28	0.01	------	------	
7:14	13,036	180.8	−56.6	0.54	28	0.01	------	------	
	14,000	156.2	−58.7	------	28	------	------	------	
	15,000	133.9	−60.8	------	28	------	------	------	
7:21	15,420	125.1	−61.7	0.21	28	------	------	------	
	16,000	114.0	−63.3	------	28	------	------	------	
	17,000	97.0	−66.1	------	28	------	------	------	
7:27	17,165	94.6	−66.6	0.28	28	------	------	------	Base of stratosphere.
	18,000	83.0	−65.6	------	28	------	------	------	
7:33	18,406	77.6	−65.1	−0.12	28	------	------	------	

OCTOBER 14, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
12:05	141	1,008.5	24.4	------	35	10.71	Calm	------	Cloudless all day.
	250	------	23.6	------	36	10.49	ene.	0.7	
	500	968.0	21.7	------	37	9.61	ene.	1.8	
	750	------	19.9	------	38	8.84	ne.	2.6	
12:06	787	936.1	19.6	0.74	38	8.67	ne.	2.7	
12:07	913	922.5	19.3	0.24	35	7.84	ne.	2.8	
	1,000	913.1	18.7	------	35	7.55	ne.	2.9	
	1,250	------	17.0	------	36	6.98	ne.	3.2	
	1,500	860.9	15.2	------	36	6.22	nne.	4.4	
	2,000	811.1	11.8	------	37	5.12	ne.	3.0	
12:12	2,269	785.9	9.9	0.69	38	4.64	ne.	7.4	
	2,500	764.3	10.7	------	36	4.63	ne.	5.9	
12:13	2,625	753.0	11.1	−0.34	36	4.62	ne.	4.9	Inversion.
	3,000	720.0	9.0	------	34	3.90	ne.	3.2	
	3,500	677.9	6.2	------	32	3.03	ene.	3.6	
	4,000	637.5	3.5	------	30	2.36	ene.	3.6	
12:17	4,047	633.7	3.2	0.55	30	2.30	ene.	3.5	
	4,500	599.3	0.8	------	28	1.81	ne.	3.3	
	5,000	563.0	−1.9	------	27	1.41	ene.	5.0	
12:22	5,555	525.2	−4.9	0.54	25	1.02	ene.	5.5	
	6,000	496.8	−6.5	------	24	0.85	ene.	6.2	
12:24	6,274	479.1	−7.5	0.36	24	0.78	ene.	6.6	
	7,000	437.7	−13.9	------	23	0.43	ene.	6.7	
	8,000	382.1	−22.6	------	22	0.18	ne.	6.6	
12:31	8,091	377.5	−23.4	0.87	22	0.16	ne.	6.4	
12:32	8,470	358.3	−26.1	0.71	22	0.13	ne.	5.8	
12:33	8,831	340.8	−27.8	0.47	22	0.11	ne.	5.6	
	9,000	333.0	−29.4	------	22	0.09	ne.	5.4	
	10,000	289.6	−39.0	------	24	0.03	nw.	4.9	
12:37	10,037	288.1	−39.4	0.96	24	0.03	nw.	5.1	Adiabatic.
12:40	10,942	252.6	−42.3	0.32	25	0.02	w.	8.6	
	11,000	250.1	−42.9	------	25	0.02	w.	9.0	
12:41	11,365	237.9	−46.5	0.99	25	0.02	wnw.	10.1	Adiabatic.
12:42	11,661	227.6	−46.6	0.03	25	0.02	w.	10.4	Isothermal.
	12,000	216.3	−48.2	------	25	0.01	w.	11.8	
12:44	12,243	208.7	−49.4	0.48	25	0.01	w.	14.5	

OCTOBER 14, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
3:53	141	1,003.1	25.4	------	33	10.72	ene.	2.2	Cloudless all day.
	250	------	24.4	------	------	------	ene.	2.4	
	500	962.4	22.1	------	------	------	e.	2.5	
	750	------	19.8	------	------	------	e.	3.5	
3:57	778	932.3	19.5	0.93	------	------	e.	3.5	Adiabatic.
	1,000	908.2	17.5	------	------	------	e.	3.8	
	1,250	------	15.3	------	------	------	e.	4.0	
	1,500	856.4	13.1	------	------	------	ene.	5.0	
4:02	1,833	822.9	10.2	0.88	------	------	ene.	7.5	
	2,000	806.6	10.0	------	------	------	ene.	8.1	
4:04	2,297	778.4	9.6	0.13	------	------	ene.	6.5	
	2,500	759.2	8.2	------	------	------	nne.	4.3	
	3,000	714.1	4.8	------	------	------	nne.	2.7	
	3,500	672.0	1.4	------	------	------	nnw.	0.8	
4:11	3,595	664.1	0.8	0.68	------	------	ne.	1.0	
	4,000	631.8	−1.4	------	------	------	ene.	2.4	
	4,500	593.4	−4.1	------	------	------	ene.	3.2	
4:17	4,862	566.9	−6.1	0.55	------	------	ene.	4.5	
	5,000	557.0	−7.1	------	------	------	ene.	5.2	
	6,000	489.3	−14.1	------	------	------	e.	5.0	
4:24	6,235	474.3	−15.8	0.71	------	------	e.	5.3	
	7,000	428.3	−21.4	------	------	------	e.	4.2	
4:31	7,711	389.1	−28.2	0.84	------	------	ne.	6.2	
	8,000	373.1	−30.4	------	------	------	ne.	6.6	
	9,000	323.0	−38.0	------	------	------	ne.	5.5	
	10,000	280.7	−45.6	------	------	------	nnw.	4.1	

TABLE 2.—*Tabulated data*—Continued

OCTOBER 14, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P.ct.	Mb.		M.p.s.	
4:41	10,035	279.4	−45.9	0.76			nnw.	4.0	
	11,000	243.4	−51.0				wnw.	9.7	
	12,000	208.3	−56.2				w.	13.0	
4:52	12,038	207.0	−56.4	0.52			w.	13.0	
	13,000	178.0	−61.7				w.	17.0	
5:03	13,759	158.1	−65.8	0.55			w.	18.2	
	14,000	152.1	−66.8				w.	17.1	
5:09	14,796	134.1	−69.9	0.40			w.	18.0	Base of stratosphere.
	15,000	130.1	−70.0				w.	15.4	
	16,000	110.8	−70.3				w.	12.8	
5:17	16,545	100.8	−70.5	0.03			wnw.	12.8	

OCTOBER 15, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
12:06	141	1,006.1	14.6		74	12.30	ese.	2.2	Cloudless all day.
	250		17.1		61	11.90	ese.	4.1	
12:07	373	979.1	19.9	−2.28	46	10.70	ese.	5.6	Inversion.
	500	965.0	19.3		46	10.30	ese.	6.2	
	750		18.0		45	9.29	e.	4.1	
	1,000	910.3	16.8		45	8.61	ene.	2.7	
12:09	1,103	899.1	16.3	0.49	45	8.34	ene.	3.6	
	1,250		15.4		44	7.70	ne.	4.7	
	1,500	858.0	13.9		43	6.83	ne.	5.6	
	2,000	808.5	10.9		40	5.22	ene.	5.6	
12:13	2,006	807.9	10.9	0.60	40	5.22	ene.	5.6	
12:14	2,421	768.7	10.9	0.00	34	4.43	ene.	6.3	Isothermal.
	2,500	761.0	10.4		34	4.29	ene.	6.3	
	3,000	716.2	7.3		32	3.27	ene.	7.4	
12:18	3,426	680.6	4.7	0.62	30	2.56	ene.	6.9	
	3,500	674.5	4.2		30	2.48	ene.	6.8	
	4,000	634.7	0.9		28	1.83	ene.	6.7	
	4,500	596.0	−2.4		27	1.35	e.	6.6	
12:23	4,912	565.8	−5.1	0.66	26	1.04	e.	6.4	
	5,000	559.7	−5.1		26	1.04	e.	6.4	
12:24	5,216	544.5	−5.0	−0.03	25	1.01			Inversion.
	6,000	493.4	−13.0		24	0.48			
12:30	6,632	453.1	−19.4	1.02	24	0.27			Superadiabatic.
	7,000	431.0	−22.5		24	0.20			
	8,000	376.0	−30.9		22	0.08			
12:37	8,453	353.1	−34.7	0.84	22	0.05			
	9,000	327.0	−39.0		21	0.03			
	10,000	283.3	−46.7		20	0.02			
12:43	10,318	270.1	−49.2	0.78	20	0.01			
	11,000	244.0	−53.0		20	0.01			
12:51	11,967	209.9	−58.3	0.55	20				
	12,000	208.5	−60.1		20				
	13,000	178.3	−63.8		19				
12:57	13,591	162.9	−67.0	0.54	18				Base of stratosphere.
	14,000	152.4	−67.2		18				
	15,000	129.2	−67.8		18				
	16,000	110.0	−68.3		18				
1:14	16,316	105.2	−68.5	0.06	18				

OCTOBER 15, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
7:48	[1] 27,671	17.7	−56.8	−0.02	10				Cloudless all day.
	27,000	20.2	−56.9						
	26,000	24.1	−57.2						
	25,000	28.2	−57.4						
	24,000	32.8	−57.6						
	23,000	37.9	−57.8						
	22,000	43.7	−58.0						
7:52	21,117	49.5	−58.2	−0.22					
	21,000	50.3	−58.5						
	20,000	58.7	−60.6						
	19,000	69.1	−62.8						
7:55	18,700	72.4	−63.4	0.01					
	18,000	81.9	−63.3						
	17,000	96.5	−63.3						
	16,000	112.4	−63.2						
	15,000	131.0	−63.1						
8:01	14,087	150.8	−63.0	0.35					Base of stratosphere.
	14,000	152.9	−62.7						
	13,000	179.8	−59.2				w.	18.8	
	12,000	208.9	−55.7				w.	15.4	
8:07	11,413	228.1	−53.7	0.73			w.	12.5	
	11,000	242.8	−50.7				w.	9.0	
	10,000	281.6	−43.4				nnw.	1.0	
	9,000	324.0	−36.1				ene.	1.6	
8:12	8,289	358.7	−30.9	0.92			ne.	2.0	Adiabatic.
	8,000	373.2	−28.2				ne.	2.2	
	7,000	428.1	−19.0				e.	2.4	
	6,000	487.2	−9.7				ene.	5.0	
8:18	5,973	489.4	−9.5	0.42			ene.	4.8	
	5,000	555.8	−5.4				ene.	4.0	
	4,500	591.4	−3.3				e.	3.1	
	4,000	628.3	−1.2				ene.	4.8	
	3,500	668.1	0.9				ene.	6.6	

[1] Descent used; temperatures inaccurate on ascent.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 15, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.	M.	Mb.	°C.		P.ct.	Mb.		M.p.s.	
8.18	3,000	710.9	3.0				ene.	7.2	
	2,500	756.2	5.1				ene.	7.6	
8:24	2,436	762.6	5.4	0.20			ene.	8.0	
8:25	1,996	804.6	6.3	0.37			ene.	8.5	
	1,500	854.2	8.1				ene.	9.6	
	1,250	880.3	9.1				ne.	8.5	
8:27	1,077	899.4	9.7	0.10			ne.	6.5	Isothermal.
	1,000	907.1	9.8				ne.	6.3	
	750	935.0	10.0				ene.	4.6	
	500	963.2	10.3				ese.	5.4	
	250	992.2	10.5				ese.	3.0	
8:29	141	1006.4	10.6				ese.	2.2	

OCTOBER 15, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
12:11	141	1,007.1	22.6		38	10.43	ese.	2.7	Cloudless all day.
	250		21.5		38	9.75	e.	2.7	
	500	966.1	18.9		39	8.52	ene.	2.8	
	750		16.2		40	7.37	ene.	3.4	
	1,000	910.6	13.6		40	6.69	ene.	5.4	
12:14	1,223	887.0	11.3	1.04	41	5.49	ene.	7.2	Adiabatic.
	1,250		11.4		40	5.39	ene.	7.6	
12:15	1,492	859.1	12.0	−0.26	36	5.05	ene.	10.2	Inversion.
	1,500	858.1	12.0		36	5.05	ene.	10.2	
12:17	1,989	809.5	11.3	0.14	34	4.55	ene.	9.5	
	2,000	808.3	11.3		34	4.55	ene.	9.5	
	2,500	761.4	9.1		33	3.81	ene.	8.6	
12:20	2,685	744.5	8.3	0.43	32	3.50	ene.	7.8	
	3,000	716.5	6.2		31	2.94	ene.	7.2	
	3,500	674.4	2.8		30	2.24	e.	6.6	
	4,000	633.4	−0.5		28	1.64	e.	6.6	
12:24	4,009	632.6	−0.6	0.67	28	1.63	e.	6.6	
	4,500	595.3	−4.1		27	1.17	e.	6.9	
	5,000	558.7	−7.6		27	0.87	e.	5.0	
	5,500	524.0	−11.2		26	0.61	e.	2.2	
12:30	5,794	504.1	−13.3	0.71	26	0.51	e.	2.8	
	6,000	490.6	−14.9		26	0.44	e.	2.6	
	7,000	429.6	−22.7		25	0.20	ese.	1.3	
12:35	7,505	400.5	−26.7	0.78	25	0.14	ene.	2.0	
	8,000	375.1	−30.3		25	0.09	ene.	3.2	
	9,000	326.0	−37.6		24	0.04	ene.	1.4	
12:42	9,767	291.4	−43.2	0.73	24	0.02	wsw.	3.4	
	10,000	282.0	−44.4		24	0.02	wsw.	4.2	
	11,000	244.4	−49.7		26	0.01	w.	9.0	
12:49	11,961	210.3	−54.8	0.53	28	0.01	w.	10.8	
	12,000	209.3	−54.9		28	0.01	wsw.	11.2	
	13,000	180.5	−58.0		31		wsw.	19.4	
	14,000	154.2	−61.1		34		wsw.	17.4	
1:00	14,819	135.1	−63.6	0.31	36		wsw.	16.4	
	15,000	131.2	−64.2		36		wsw.	18.3	
1:04	15,630	118.4	−66.1	0.31	37		w.	20.2	Base of stratosphere.
	16,000	111.9	−66.5		36		w.	17.5	
1:11	16,776	98.5	−67.3	0.10	35		w.	15.5	

OCTOBER 15, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
4:07	141	1,005.1	23.9		32	9.50	ne.	4.5	Cloudless all day.
	250		23.0		33	9.28	ne.	4.4	
	500	964.0	21.1		35	8.76	ene.	4.3	
	750		19.1		37	8.18	ene.	4.8	
	1,000	908.9	17.1		39	7.61	ene.	5.4	
	1,250		15.1		41	7.04	ene.	6.7	
	1,500	857.9	13.1		43	6.48	e.	8.7	
4:10	1,526	855.1	12.9	0.79	43	6.40	e.	8.8	
4:11	1,866	821.3	12.3	0.18	38	5.44	e.	10.4	
	2,000	808.6	11.6		37	5.05	e.	10.1	
	2,500	761.4	8.9		34	3.88	ene.	10.0	
4:15	2,882	726.7	6.8	0.54	32	3.16	ene.	8.5	
	3,000	716.3	6.8		32	3.16	ene.	7.9	
4:16	3,135	704.5	6.8	0.00	31	3.06	ne.	7.3	Isothermal.
	3,500	674.0	4.6		30	2.54	ene.	7.1	
	4,000	634.0	1.5		29	1.97	e.	6.8	
	4,500	595.8	−1.5		28	1.51	ese.	3.8	
4:21	4,648	584.7	−2.4	0.61	28	1.40	ese.	3.0	
	5,000	559.2	−4.6		27	1.13	sse.	1.0	
	6,000	492.0	−10.7		22	0.54	ene.	2.8	
4:26	6,117	484.6	−11.4	0.61	22	0.51	ene.	3.2	
	7,000	432.5	−18.4		21	0.26	nne.	2.2	
4:31	7,512	403.0	−22.4	0.79	20	0.17	ne.	2.6	
	8,000	378.0	−26.6		20	0.11	ene.	1.5	
	9,000	328.6	−35.1		20	0.04	se.	0.8	
4:38	9,204	319.4	−36.9	0.86	20	0.04	ssw.	1.0	
	10,000	284.7	−44.0		20	0.02	w.	6.2	
4:45	10,620	259.8	−49.6	0.90	20	0.01	w.	9.7	Adiabatic.
	11,000	246.0	−52.2		20	0.01	w.	12.1	
4:51	11,919	213.5	−58.6	0.69	20		wsw.	12.8	
	12,000	211.0	−58.8		20		wsw.	13.2	
	13,000	180.2	−61.7		20		wsw.	22.1	

TABLE 2.—*Tabulated data*—Continued

OCTOBER 15, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P. ct.	Mb.		M. p. s.	
5:00	13,623	163.6	−63.5	0.29	20		wsw.	20.1	
	14,000	154.2	−64.6		20		wsw.	19.4	
	15,000	131.4	−67.7		19		wsw.	21.4	
5:08	15,563	120.1	−69.4	0.30	18		w.	24.1	Base of stratosphere.
	16,000	112.1	−69.3		18		wnw.	19.7	
	17,000	95.1	−69.0		18		wnw.	9.4	
5:17	17,150	92.8	−69.0	−0.03	18		wnw.	7.0	

OCTOBER 16, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
6:33	141	1,006.1	9.5		88	10.45	ne.	1.3	Few Ci, WSW.
	250		11.3				ene.	3.0	
6:34	492	964.9	15.2	−1.62			ene.	5.6	Inversion.
	500	964.0	15.2				ene.	5.6	
	750		14.3				ene.	5.2	Clear all day.
	1,000	908.2	13.5				ne.	5.0	
6:37	1,138	893.9	13.0	0.34			ene.	5.5	
	1,250		13.4				ene.	6.5	
	1,500	856.2	14.2				ene.	9.0	
6:38	1,535	852.8	14.3	−0.33			ene.	9.1	Inversion.
	2,000	806.1	11.0				ene.	11.2	
	2,500	759.8	7.5				ene.	16.0	
6:42	2,821	730.6	5.3	0.70			ene.	13.4	
	3,000	715.0	5.1				ene.	11.0	
6:44	3,159	701.1	5.0	0.09			ene.	10.4	Isothermal.
	3,500	672.9	2.9				ene.	9.1	
6:47	3,969	634.4	0.0	0.62			ene.	5.1	
	4,000	631.9	−0.1				ene.	5.0	
	4,500	593.4	−2.4				ene.	2.5	
	5,000	557.1	−4.7				ne.	1.4	
6:53	5,418	528.3	−6.6	0.46			nne.	2.1	
	6,000	490.2	−11.0				nne.	1.6	
	7,000	430.0	−18.5				nw.	1.1	
7:01	7,008	429.8	−18.5	0.75			nw.	1.1	
	8,000	375.5	−25.1				w.	3.2	
7:06	8,415	355.1	−27.9	0.67			wnw.	9.0	
	9,000	328.0	−32.6				w.	11.2	
	10,000	284.5	−40.5				w.	9.1	
7:16	10,358	269.8	−43.4	0.80			w.	10.1	
	11,000	245.3	−47.5				w.	11.8	
	12,000	211.0	−53.9				w.	21.8	
7:27	12,527	194.9	−57.3	0.64			w.	26.8	Base of stratosphere.
	13,000	181.6	−58.1				w.	27.6	
	14,000	155.5	−59.7				w.	24.2	
7:33	14,018	155.0	−59.7	0.16			w.	24.1	

OCTOBER 17, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
6:35	141	1,003.1	10.9		93	12.13	n.	0.9	4 Ci, ESE.
	250		14.9		83	14.07	n.	3.3	
6:36	384	974.7	19.7	−3.62	70	16.07	n.	5.0	Inversion.
	500	961.9	19.3		69	15.46	n.	4.9	
6:37	740	935.5	18.6	0.31	68	14.58	nne.	4.8	Clear after 9 a. m.
	750		18.5		68	14.49	nne.	4.8	
	1,000	907.1	16.3		68	12.61	ne.	4.8	
	1,250		14.2		68	11.02	ne.	4.6	
6:40	1,326	873.1	13.5	0.87	68	10.53	ne.	5.1	
	1,500	855.1	12.7		64	9.40	ne.	6.0	
	2,000	805.6	10.4		52	6.56	ne.	6.3	
6:43	2,251	781.7	9.3	0.45	46	5.39	ne.	6.2	
	2,500	759.3	7.8		44	4.66	ne.	6.6	
	3,000	716.0	4.7		40	3.42	ne.	7.2	
6:47	3,411	678.3	2.1	0.62	36	2.56	nne.	6.0	
	3,500	673.0	1.7		36	2.48	nne.	5.8	
	4,000	630.8	−0.8		34	1.94	ene.	5.2	
6:50	4,152	618.8	−1.6	0.50	34	1.82	ene.	6.4	
	4,500	592.5	−2.5		32	1.59	ene.	8.0	
6:51	4,518	591.2	−2.5	0.25	32	1.59	ene.	7.9	
	5,000	556.2	−5.7		31	1.18	e.	6.2	
6:54	5,473	523.9	−8.8	0.66	30	0.87	e.	6.2	
	6,000	490.1	−12.2		29	0.62	ese.	5.8	
	7,000	429.1	−18.6		28	0.33	e.	7.9	
6:59	7,035	427.1	−18.8	0.64	28	0.33	e.	7.9	
	8,000	374.9	−27.7		28	0.14	ese.	8.3	
7:04	8,201	364.4	−29.6	0.93	28	0.11	ese.	8.7	Adiabatic.
	9,000	325.7	−37.1		28	0.05	ese.	6.7	
7:08	9,315	311.0	−40.1	0.94	28	0.03	ese.	6.4	Adiabatic.
	10,000	281.0	−44.6		28	0.02	e.	10.0	
	11,000	242.0	−51.1		28	0.01			
7:16	11,695	218.4	−55.6	0.65	28	0.01			Base of stratosphere.
	12,000	209.0	−55.8		28	0.01			
	13,000	180.0	−56.0		28	0.01			
7:23	13,512	165.5	−56.2	0.03	28	0.01			

TABLE 2.—*Tabulated data*—Continued

OCTOBER 17, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P. ct.	Mb.		M. p. s.	
4:15	141	1,004.7	26.3		35	11.95	nne.	3.1	2 Ci., ESE.
	250		25.4				nne.	4.1	
	500	965.0	23.2				nne.	5.3	Clear all day.
	750		21.1				nne.	5.4	
4:19	926	918.3	19.6	0.85			nne.	5.3	
	1,000	910.5	18.9				nne.	5.3	
	1,250		16.4				nne.	5.5	
	1,500	859.0	13.9				nne.	5.8	
4:24	1,748	833.5	11.4	1.00			nne.	5.7	Adiabatic.
4:25	1,900	818.5	11.9	−0.33			nne.	5.5	Inversion.
	2,000	809.0	11.2				nne.	5.6	
	2,500	761.8	7.9				ne.	7.7	
	3,000	717.0	4.6				nne.	6.5	
4:31	3,132	705.1	3.7	0.66			nne.	6.3	
	3,500	674.0	3.5				nne.	4.4	
4:33	3,509	673.0	3.5	0.05			nne.	4.3	Isothermal.
	4,000	634.0	0.4				ne.	4.5	
	4,500	595.2	−2.8				ne.	6.8	
	5,000	558.8	−6.0				nne.	7.3	
	6,000	491.7	−12.3				ene.	2.8	
4:47	6,515	459.7	−15.6	0.64			e.	5.1	
	7,000	431.1	−20.7				e.	4.9	
4:54	7,529	401.3	−26.3	1.05			ese.	9.2	Adiabatic.
	8,000	376.0	−29.7				ese.	15.4	
	9,000	327.3	−36.9				ese.	9.6	
5:03	9,563	301.8	−40.9	0.72			ese.	5.0	
	10,000	284.7	−43.4				e.	5.7	
	11,000	246.0	−49.2				e.	12.2	
5:15	11,739	218.9	−53.4	0.58			se.	7.6	
	12,000	209.8	−54.1				ssw.	10.2	
	13,000	178.3	−56.7				w.	13.1	
	14,000	152.5	−59.3				wnw.	12.8	
	15,000	131.8	−61.9				wnw.	11.1	
5:36	[1]15,375	124.9	−62.9	0.26			wnw.	11.4	Base of stratosphere.
	16,000						wnw.	6.0	
	17,000						wnw.	3.0	
5:59	17,921						nw.	3.0	

OCTOBER 18, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt/100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
6:34	141	1,005.8	11.0		93	12.21	ese.	2.1	Cloudless all day.
	250		12.1				ese.	4.0	
6:34½	304	986.3	12.6	−0.98			ese.	4.9	Inversion.
6:35	435	971.0	12.6	0.00			ese.	7.1	Isothermal.
	500	963.7	13.0				ese.	7.6	
	750		14.4				e.	4.1	
6:37	957	913.0	15.6	−0.57			nne.	3.8	Inversion.
	1,000	908.1	15.4				n.	3.8	
	1,250		13.9				nnw.	5.5	
6:38	1,341	872.4	13.4	0.57			nnw.	6.2	
6:39	1,497	856.3	13.5	−0.06			nnw.	7.4	Inversion.
	2,000	807.2	10.2				n.	10.4	
6:41	2,434	765.4	7.4	0.65			nne.	10.2	
	2,500	759.4	7.4				nne.	10.0	
6:42	2,672	743.6	7.4	0.00			nne.	9.2	Isothermal.
	3,000	713.8	5.3				nne.	8.2	
	3,500	671.0	2.1				nne.	8.0	
	4,000	631.0	−1.1				nne.	8.5	
6:47	4,094	623.9	−1.7	0.64			nne.	9.0	
	4,500	593.0	−3.8				ne.	10.0	
	5,000	556.8	−6.4				ne.	8.2	
6:53	5,758	505.3	−10.3	0.52			ne.	5.8	
	6,000	489.8	−12.3				nne.	4.9	
6:57	6,940	432.5	−20.1	0.83			ne.	3.3	
	7,000	429.5	−20.6				ne.	3.5	
	8,000	375.8	−29.3				ne.	5.6	
7:05	8,842	332.7	−36.7	0.87			ene.	7.8	
	9,000	325.4	−37.6				ene.	8.4	
	10,000	280.7	−43.4				e.	11.0	
7:12	10,843	249.0	−48.3	0.58			ese.	7.3	
	11,000	243.2	−49.0				ese.	6.2	
	12,000	210.0	−53.4				w.	10.3	
	13,000	179.4	−57.9				w.	13.8	
7:21	13,023	178.8	−58.0	0.45			w.	13.9	
	14,000	154.0	−60.1				w.	14.5	
	15,000	131.8	−62.2				w.	15.8	
7:29	15,017	131.3	−62.2	0.21			w.	15.8	Base of stratosphere.
	16,000	112.2	−61.3				wsw.	12.6	
7:42	16,976	96.4	−60.5	−0.09			wnw.	10.2	

[1] Altitudes above 15,375 m. obtained from two theodolite observations.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 18, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m	*M.*	*Mb.*	*°C.*		*P.ct.*	*Mb.*		*M.p.s.*	
4:03	141	1,003.7	27.0	------	38	13.56	ne.	2.7	Cloudless all day.
	250	------	25.8	------	------	------	ne.	3.2	
4:05	500	963.0	23.1	------	------	------	nne.	3.8	
	652	946.9	21.4	1.09	------	------	nne.	3.8	Superadiabatic.
	750	------	20.4	------	------	------	nne.	3.9	
4:07	1,000	909.0	17.7	------	------	------	nne.	4.8	
	1,178	890.5	15.8	1.06	------	------	nne.	5.8	Superadiabatic.
	1,250	------	15.5	------	------	------	nne.	6.3	
	1,500	858.3	14.5	------	------	------	nne.	7.4	
	2,000	809.2	12.4	------	------	------	n.	9.6	
	2,500	762.0	10.3	------	------	------	n.	8.6	
4:15	3,000	717.0	8.3	------	------	------	n.	8.8	
4:16	3,260	694.6	7.2	0.41	------	------	nne.	7.6	
	3,389	683.8	7.7	−0.39	------	------	nne.	6.8	Inversion.
	3,500	674.3	7.0	------	------	------	ne.	6.7	
	4,000	634.0	3.8	------	------	------	ene.	8.5	
4:21	4,500	596.0	0.5	------	------	------	ene.	9.1	
	4,892	568.3	−2.0	0.65	------	------	ene.	8.2	
	5,000	561.0	−2.7	------	------	------	ene.	7.6	
4:28	6,000	495.0	−9.2	------	------	------	ne.	6.2	
	6,744	448.0	−14.1	0.65	------	------	e.	9.2	
	7,000	433.5	−16.3	------	------	------	e.	10.0	
	8,000	379.3	−24.8	------	------	------	e.	10.8	
4:38	9,000	330.3	−33.3	------	------	------	e.	11.1	
	9,213	320.8	−35.1	0.85	------	------	ese.	10.3	
	10,000	287.0	−36.3	------	------	------	ese.	8.7	
4:47	11,000	248.5	−37.8	------	------	------	ssw.	4.4	
	11,357	235.5	−38.4	0.15	------	------	wsw.	7.6	
	12,000	214.4	−42.8	------	------	------	wsw.	13.4	
	13,000	183.6	−49.6	------	------	------	wsw.	20.1	
5:00	14,000	157.4	−56.4	------	------	------	w.	19.8	
	14,526	145.9	−60.0	0.68	------	------	wsw.	15.2	
	15,000	136.4	−61.5	------	------	------	wsw.	14.5	
5:10	16,000	118.0	−64.7	------	------	------	w.	10.8	
	16,561	106.1	−66.5	0.32	------	------	w.	8.5	Probably base of stratosphere.

OCTOBER 19, 1927

A. m.									
6:34	141	1,003.7	9.1	------	94	10.87	sw.	3.3	Cloudless all day.
	250	------	11.0	------	------	------	sw.	2.8	
6:36	500	961.0	15.5	------	------	------	sw.	2.2	
	607	949.7	17.4	−1.78	------	------	w.	2.2	Inversion.
	750	------	16.6	------	------	------	nw.	2.4	
6:38	1,000	906.6	15.1	------	------	------	n.	4.1	
6:39	1,071	899.3	14.7	0.58	------	------	n.	5.0	
	1,230	882.6	15.2	−0.31	------	------	n.	7.0	Inversion.
	1,250	------	15.1	------	------	------	n.	7.3	
6:41	1,500	854.7	13.9	------	------	------	n.	9.4	
	1,959	809.3	11.8	0.47	------	------	nne.	8.8	
6:42	2,000	805.2	11.7	------	------	------	nne.	8.8	
	2,182	788.1	11.4	0.18	------	------	ne.	8.7	
6:44	2,500	758.8	9.6	------	------	------	ne.	8.5	
	2,994	714.6	6.9	0.55	------	------	ne.	8.4	
	3,000	714.0	6.9	------	------	------	ne.	8.4	
6:48	3,500	672.0	5.8	------	------	------	ne.	9.6	
	[1] 3,657	659.3	5.5	0.21	------	------	ne.	10.1	
	4,000	631.9	2.6	------	------	------	ne.	9.2	
6:53	4,500	593.6	−1.7	------	------	------	ene.	7.0	
	4,971	559.8	−5.7	0.85	------	------	e.	7.0	
	5,000	557.6	−5.9	------	------	------	e.	7.0	
	6,000	489.9	−12.9	------	------	------	e.	6.7	
7:03	7,000	426.3	−19.8	------	------	------	se.	4.4	
	7,441	399.2	−22.9	0.70	------	------	ese.	6.7	
	8,000	370.9	−27.6	------	------	------	ese.	9.6	
	9,000	323.6	−36.0	------	------	------	ese.	9.2	
7:15	10,000	282.0	−44.4	------	------	------	se.	6.0	
	10,161	276.0	−45.8	0.84	------	------	sse.	4.8	
	11,000	246.0	−48.6	------	------	------	sw.	10.1	
	12,000	213.0	−51.9	------	------	------	wsw.	28.8	
7:27	13,000	182.0	−55.3	------	------	------	wsw.	30.2	
	13,391	169.8	−56.6	0.33	------	------	wsw.	27.2	
7:31	14,000	154.9	−62.4	------	------	------	wsw.	26.9	
	14,091	152.5	−63.3	0.96	------	------	wsw.	27.6	Adiabatic.
	15,000	133.0	−65.1	------	------	------	wsw.	15.4	
7:42	16,000	114.3	−67.1	------	------	------	w.	10.2	
	16,221	108.7	−67.6	0.20	------	------	w.	10.4	Base of stratosphere.
7:52	17,000	97.0	−65.3	------	------	------	wsw.	9.5	
	17,801	84.4	−62.9	−0.30	------	------	wsw.	3.2	

OCTOBER 19, 1927

P. m.									
3:44	141	1,000.0	26.7	------	42	14.73	wsw.	2.6	Cloudless all day
	250	------	25.7	------	------	------	wsw.	2.7	
	500	960.2	23.6	------	------	------	wsw.	3.0	
	750	------	21.4	------	------	------	w.	3.5	
	1,000	905.9	19.2	------	------	------	nw.	4.4	

[1] Pressures above 3,657 m. computed from heights obtained from 2 theodolite observations and recorded temperatures.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 19, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	*M.*	*Mb.*	*°C.*		*P.ct.*	*Mb.*		*M.p.s.*	
3:47	1,035	902.4	18.9	0.87	------	------	nw.	4.4	
	1,250	------	17.8	------	------	------	nnw.	5.0	
	1,500	------	16.5	------	------	------	nnw.	4.9	
	2,000	805.2	14.0	------	------	------	n.	4.4	
	2,500	759.0	11.5	------	------	------	nne.	6.0	
3:52	2,530	756.5	11.3	0.51	------	------	nne.	6.0	
3:54	2,798	732.9	10.8	0.19	------	------	ne.	7.1	
	3,000	715.1	9.4	------	------	------	ne.	8.8	
	3,500	673.0	5.9	------	------	------	nne.	8.7	
	4,000	633.0	2.4	------	------	------	nne.	8.5	
	4,500	595.0	−1.0	------	------	------	nne.	8.2	
	5,000	558.2	−4.5	------	------	------	nne.	7.3	
4:05	5,749	508.0	−9.7	0.70	------	------	ne.	5.7	
	6,000	492.1	−11.5	------	------	------	ne.	5.4	
	7,000	432.8	−18.8	------	------	------	ne.	4.8	
4:12	7,588	399.0	−23.1	0.73	------	------	e	4.3	
	8,000	377.0	−26.5	------	------	------	ese.	5.5	
	9,000	328.0	−34.7	------	------	------	e	9.9	
4:19	9,010	327.5	−34.8	0.82	------	------	e.	9.8	
	10,000	284.8	−40.2	------	------	------	sw.	7.0	
4:22	10,228	275.5	−41.4	0.54	------	------	wsw.	13.1	
	11,000	246.1	−41.5	------	------	------	wsw.	18.4	
4:25	11,140	241.3	−41.5	0.01	------	------	wsw.	19.5	Isothermal.
	12,000	213.2	−45.2	------	------	------	wsw.	24.8	
4:30	12,326	203.0	−46.6	0.43	------	------	w.	24.4	
	13,000	184.0	−49.4	------	------	------	wsw.	24.0	
	14,000	158.2	−53.5	------	------	------	wsw.	22.9	
4:39	14,539	146.0	−55.7	0.41	------	------	wsw	19.7	
	15,000	136.2	−58.3	------	------	------	wsw.	21.4	
4:44	15,805	119.7	−62.9	0.57	------	------	------	------	

OCTOBER 20, 1927

A. m.									
6:27	141	1,000.0	11.1	------	93	12.28	ssw.	1.8	Cloudless all day.
	250	------	14.3	------	------	------	wsw.	6.0	
	500	959.0	21.8	------	------	------	wnw.	9.0	
6:28	524	956.0	22.5	−2.98	------	------	wnw.	8.7	Inversion.
	750	------	21.4	------	------	------	nw.	7.1	
	1,000	904.8	20.1	------	------	------	nw.	6.3	
	1,250	------	18.8	------	------	------	nnw.	4.7	
6:31	1,492	854.6	17.6	0.51	------	------	ne.	4.2	
	1,500	853.6	17.5	------	------	------	ne.	4.2	
	2,000	805.0	14.1	------	------	------	ne.	2.6	
	2,500	758.5	10.7	------	------	------	n.	3.8	
	3,000	713.9	7.2	------	------	------	nnw.	5.2	
6:38	3,481	673.1	3.9	0.69	------	------	nnw.	4.7	
	3,500	671.6	3.9	------	------	------	nnw.	4.6	
6:39	3,652	659.1	4.2	−0.18	------	------	nnw.	4.0	Inversion.
	4,000	631.3	2.9	------	------	------	ne.	2.0	
6:40	4,034	628.7	2.8	0.37	------	------	ene.	2.0	
	4,500	593.4	−0.2	------	------	------	e.	7.4	
	5,000	557.9	−3.5	------	------	------	ene.	8.5	
	6,000	491.0	−10.0	------	------	------	ese.	8.4	
6:45	6,267	474.5	−11.7	0.65	------	------	ese.	8.8	
	7,000	431.4	−18.5	------	------	------	e.	11.4	
6:52	7,811	386.3	−26.0	0.92	------	------	ese.	13.0	Adiabatic.
	8,000	376.9	−27.3	------	------	------	ese.	12.7	
	9,000	328.0	−34.5	------	------	------	ese.	8.9	
6:59	9,712	295.8	−39.6	0.72	------	------	se.	6.3	
	10,000	283.9	−41.1	------	------	------	se.	4.0	
	11,000	245.9	−46.1	------	------	------	wsw.	6.1	
	12,000	211.8	−51.2	------	------	------	wsw.	10.4	
7:07	12,230	204.2	−52.3	0.51	------	------	wsw.	11.8	
	13,000	182.2	−55.8	------	------	------	wsw.	21.3	
	14,000	156.0	−60.2	------	------	------	w.	20.8	
	15,000	133.2	−64.7	------	------	------	w.	13.8	
7:17	15,033	132.6	−64.9	0.45	------	------	w.	13.8	Probably base of stratosphere.
	16,000	115.3	−67.6	------	------	------	wnw.	9.0	
	17,000	99.0	−70.4	------	------	------	------	------	
7:25	17,631	87.5	−72.2	0.28	------	------	------	------	

OCTOBER 21, 1927

A. m.									
6:30	141	1,000.0	11.8	------	89	12.32	n.	1.4	3 Ci, SSW.
	250	------	15.6	------	73	12.94	nne.	2.0	
6:31	483	960.7	23.7	−3.48	40	11.73	ene.	2.5	Inversion.
	500	959.0	23.6	------	40	11.66	ene.	2.6	
	750	------	22.0	------	39	10.32	ene.	3.3	Clear in morning; partly cloudy in afternoon.
	1,000	905.0	20.5	------	39	9.41	ene.	3.6	
	1,250	------	18.9	------	38	8.30	ene.	3.4	
6:35	1,486	855.4	17.4	0.63	38	7.55	ne.	3.0	
	1,500	854.0	17.4	------	37	7.36	ne.	3.0	
6:36	1,700	834.2	17.4	0.00	30	5.96	nne.	2.7	Isothermal.
	2,000	804.0	15.3	------	30	5.22	nne.	2.5	
	2,500	754.0	11.7	------	29	3.99	nne.	2.8	
6:40	3,000	714.8	8.2	0.71	28	3.04	ese.	1.8	
	3,500	674.0	4.8	------	28	2.41	ese.	1.9	
	4,000	634.1	1.4	------	29	1.96	sse.	2.5	
	4,500	595.7	−2.0	------	29	1.50	se.	1.8	
	5,000	558.7	−5.5	------	30	1.16	sse.	2.0	

TABLE 2.—*Tabulated data*—Continued

OCTOBER 21, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.	M.	Mb.	°C.		P. ct.	Mb.		M. p. s.	
6:48	5,313	536.1	−7.6	0.68	30	0.97	se.	2.6	
	6,000	489.3	−12.4	------	28	0.59	se.	3.4	
	7,000	429.8	−19.5	------	26	0.29	se.	8.8	
6:54	7,271	414.9	−21.4	0.71	25	0.23	sse.	9.9	
	8,000	377.5	−27.3	------	24	0.12	sse.	8.3	
7:00	8,542	351.4	−31.7	0.81	24	0.08	ssw.	3.8	
	9,000	329.0	−35.9	------	24	0.06	ssw.	5.5	
	10,000	283.0	−45.1	------	24	0.02	sw.	6.8	
7:11	10,655	257.0	−51.1	0.92	24	0.01	sw.	10.1	Adiabatic.
	11,000	244.0	−52.3	------	24	0.01	sw.	14.9	
	12,000	210.0	−55.6	------	24	------	sw.	18.9	
7:22	12,833	184.7	−58.4	0.34	24	------	sw.	19.4	Base of stratosphere.
	13,000	179.9	−58.5	------	24	------	sw.	18.2	
	14,000	153.8	−59.2	------	23	------	sw.	18.7	
	15,000	132.0	−59.8	------	23	------	wsw.	17.2	
7:31	15,908	114.5	−60.4	0.07	22	------	------	------	

OCTOBER 21, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
4:04	141	997.6	29.0	------	37	14.84	Calm.		4 Ci., SSW.
	250	------	28.0	------	38	14.38	ne.	0.1	
	500	957.0	25.7	------	39	12.89	nne.	0.3	Clear in morning; partly cloudy in afternoon.
	750	------	23.4	------	41	11.81	n.	0.2	
	1,000	903.8	21.1	------	43	10.77	nw.	1.0	
	1,250	------	18.8	------	44	9.55	nw.	2.0	
4:08	1,355	868.0	17.8	0.92	45	9.18	nnw.	2.2	Adiabatic.
4:09	1,453	858.0	17.6	0.20	32	6.44	nnw.	2.5	
	1,500	853.3	17.2	------	32	6.28	nnw.	2.7	
	2,000	804.8	13.0	------	30	4.49	n.	2.6	
4:12	2,431	764.0	9.3	0.85	29	3.40	nne.	2.3	
	2,500	757.5	8.7	------	30	3.38	ne.	1.8	
	3,000	712.9	4.3	------	33	2.74	e.	2.0	
4:16	3,323	685.2	1.4	0.88	36	2.43	e.	4.3	
	3,500	670.2	−0.1	------	36	2.18	ese.	4.0	
4:18	3,988	631.2	−2.1	0.53	36	1.85	se.	1.8	
	4,000	630.1	−2.2	------	36	1.84	se.	1.8	
	4,500	591.6	−6.2	------	36	1.31	e.	1.6	
	5,000	554.2	−10.2	------	36	0.93	se.	1.8	
4:23	5,490	520.5	−14.1	0.80	36	0.65	sse.	5.6	
	6,000	488.1	−18.1	------	33	0.41	sse.	6.9	
	7,000	427.0	−25.9	------	28	0.16	s.	6.1	
4:30	7,353	405.4	−28.6	0.78	26	0.11	ssw.	5.0	
	8,000	371.1	−34.0	------	26	0.06	ssw.	8.0	
	9,000	321.8	−42.3	------	27	0.03	ssw.	9.5	
4:38	9,348	305.4	−45.2	0.83	27	0.02	ssw.	8.8	
	10,000	276.7	−49.3	------	27	0.01	ssw.	12.6	
4:44	10,937	241.1	−54.2	0.63	27	0.01	ssw.	13.1	
	11,000	239.0	−54.4	------	27	0.01	ssw.	13.4	
	12,000	206.0	−57.1	------	27	------	sw.	16.2	
4:53	13,004	175.5	−59.9	0.28	27	------	sw.	21.0	Base of stratosphere.
	14,000	153.0	−60.6	------	27	------	wsw.	18.9	
	15,000	132.2	−61.3	------	27	------	sw.	16.2	
	16,000	111.8	−62.0	------	27	------	wsw.	19.8	
5:06	16,538	100.6	−62.4	0.07	27	------	------	------	

OCTOBER 22, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
A. m.									
6:25	141	999.0	12.9	------	93	13.84	Calm.		
	250	------	15.9	------	80	14.46	ssw.	2.4	3 Ci, S. (2 layers), 1 Ci. Cu., SW.
	500	957.8	22.8	------	52	14.45	ssw.	4.3	
6:27	516	956.1	23.2	−2.75	50	14.23	ssw.	4.3	
	750	------	21.4	------	50	12.75	s.	3.8	Inversion.
	1,000	903.8	19.4	------	50	11.27	ssw.	2.7	
	1,250	------	17.4	------	50	9.94	wsw.	1.4	
6:33	1,493	853.6	15.5	0.79	50	8.80	wnw.	1.4	
	1,500	852.8	15.5	------	50	8.80	wnw.	1.5	
6:34	1,730	830.0	15.1	0.17	38	6.52	nw.	2.4	
	2,000	804.0	13.3	------	38	5.81	n.	2.3	
	2,500	756.7	10.1	------	37	4.57	ene.	2.6	
	3,000	713.0	6.9	------	36	3.58	ssw.	3.6	
6:43	3,210	695.0	5.5	0.65	36	3.25	sw.	4.7	
	3,500	671.0	3.1	------	36	2.75	ssw.	6.6	
	4,000	631.1	−1.1	------	37	2.06	ssw.	5.5	
	4,500	592.5	−5.3	------	38	1.49	ssw.	5.3	
6:53	4,710	576.5	−7.1	0.84	38	1.28	s.	3.4	Partly cloudy to 10 a. m., then cloudy to 5 p. m.
	5,000	555.3	−8.9	------	37	1.07	sse.	5.0	
	6,000	488.3	−15.3	------	32	0.52	sse.	5.2	
7:02	6,007	487.9	−15.3	0.63	32	0.52	sse.	5.2	
	7,000	428.2	−21.4	------	32	0.29	s.	6.5	
7:11	7,376	406.3	−23.7	0.61	32	0.23	s.	7.0	
	8,000	372.8	−28.3	------	33	0.15	ssw.	10.3	
7:23	8,626	341.8	−33.3	0.74	34	0.09	s.	15.0	
	9,000	324.5	−36.3	------	34	0.06	------	------	
7:34	9,410	306.0	−39.6	0.80	34	0.04	------	------	
	10,000	281.0	−42.2	------	38	0.04	------	------	
7:53	[1] 10,014	280.3	−42.3	0.45	38	0.04	------	------	

[1] Instrument was carried about 200 m. higher than maximum altitude tabulated but temperature element was affected by excessive insolation, due to slowing up of ascent.

TABLE 2.—*Tabulated data*—Continued

OCTOBER 23, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	M.	Mb.	°C.		P. ct.	Mb.		M. p. s.	
4:31	141	997.0	28.7	------	41	16.16	sw.	3.6	1 Ci., E.; 1 A. St; 0 (?).
	250	------	27.9	------	------	------	ssw.	4.0	
	500	957.9	26.1	------	------	------	s.	4.7	
	750	------	24.4	------	------	------	s.	5.3	Clear all day.
4:34	926	912.1	23.1	0.71	------	------	s.	5.2	
	1,000	904.5	22.3	------	------	------	s.	5.1	
	1,250	------	19.6	------	------	------	s.	4.4	
4:36	1,497	853.6	17.0	1.07	------	------	s.	3.6	Superadiabatic.
	2,000	804.9	13.0	------	------	------	wsw.	2.4	
4:39	2,397	767.4	9.8	0.80	------	------	w.	3.2	
	2,500	758.0	9.0	------	------	------	wnw.	4.3	Distant thunder cloud on nw. horizon about 2 p. m.
	3,000	713.2	5.2	------	------	------	wnw.	4.8	
	3,500	670.8	1.5	------	------	------	wnw.	4.4	
4:45	3,642	658.9	0.4	0.75	------	------	w.	3.9	
	4,000	630.0	−1.9	------	------	------	w.	3.6	
	4,500	591.3	−5.1	------	------	------	w.	4.2	
	5,000	555.0	−8.2	------	------	------	w.	5.4	
4:52	5,275	536.3	−10.0	0.64	------	------	nw.	5.5	
	6,000	489.1	−15.3	------	------	------	nw.	5.5	
4:57	6,514	456.2	−19.0	0.73	------	------	nw.	4.6	
	7,000	427.0	−22.4	------	------	------	wnw.	2.8	
5:03	7,934	376.0	−28.9	0.70	------	------	w.	3.1	
	8,000	372.9	−29.3	------	------	------	w.	2.9	
	9,000	324.1	−36.1	------	------	------	nne.	1.2	
	10,000	280.4	−42.9	------	------	------	ne.	3.2	
5:13	10,531	259.6	−46.5	0.68	------	------	wnw.	6.9	
	11,000	242.8	−46.8	------	------	------	wnw.	11.1	
	12,000	209.2	−47.6	------	------	------	wnw.	14.0	
5:20	12,046	207.9	−47.6	0.07	------	------	wnw.	14.0	Isothermal.
	13,000	181.2	−50.8	------	------	------	wnw.	14.0	
	14,000	155.4	−54.2	------	------	------	wnw.	12.7	
5:32	14,829	136.5	−57.0	0.34	------	------	w.	6.9	
	15,000	133.1	−57.7	------	------	------	w.	6.5	
	16,000	113.8	−61.5	------	------	------	w.	10.8	
5:38	16,006	113.7	−61.5	0.38	------	------	w.	10.8	
	17,000	97.2	−65.2	------	------	------	w.	7.8	
5:45	17,089	95.8	−65.8	0.37	------	------	w.	7.2	Base of stratosphere.
	18,000	83.5	−65.2	------	------	------	wnw.	3.3	
	19,000	72.7	−64.5	------	------	------	nw.	2.8	
	20,000	63.4	−63.8	------	------	------	ene.	4.8	
	21,000	55.0	−63.1	------	------	------	se.	6.2	
	22,000	46.0	−62.4	------	------	------	------	------	
6:19	22,528	40.2	−62.0	−0.07	------	------	------	------	

OCTOBER 26, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.									
3:58	141	1,001.7	29.0	------	38	15.24	e.	1.8	Few Cu., ESE.
	250	------	28.2	------	------	------	e.	1.9	
	500	961.9	26.4	------	------	------	ese.	2.2	Clear all day.
4:00	615	949.6	25.6	0.72	------	------	se.	2.2	
	750	------	24.2	------	------	------	se.	2.3	
	1,000	908.1	21.6	------	------	------	se.	2.2	
4:02	1,035	904.9	21.2	1.05	------	------	se.	2.2	Superadiabatic.
	1,250	------	19.2	------	------	------	ese.	2.4	
	1,500	857.7	17.0	------	------	------	ese.	2.5	
4:06	1,862	821.5	13.7	0.91	------	------	ese.	3.1	Adiabatic.
	2,000	808.0	12.3	------	------	------	ese.	3.8	
	2,500	760.5	7.3	------	------	------	ese.	5.0	
4:10	2,707	741.9	5.2	1.00	------	------	ese.	5.4	Adiabatic.
	3,000	716.0	4.6	------	------	------	ene.	5.0	
4:12	3,261	693.5	4.0	0.22	------	------	ne.	6.0	
	3,500	673.7	2.7	------	------	------	nne.	8.9	
4:16	3,960	636.2	0.1	0.56	------	------	n.	8.1	
	4,000	633.0	−0.2	------	------	------	n.	7.6	
	4,500	594.0	−4.2	------	------	------	nne.	9.4	
	5,000	557.9	−8.2	------	------	------	n.	9.8	
4:22	5,047	554.5	−8.6	0.80	------	------	n.	10.0	
4:25	5,500	523.5	−9.9	0.29	------	------	nnw.	12.1	
	6,000	491.6	−13.8	------	------	------	nnw.	12.0	
	7,000	431.4	−21.5	------	------	------	nnw.	13.1	
4:37	7,494	402.2	−25.4	0.78	------	------	nnw.	15.4	
	8,000	375.1	−30.2	------	------	------	nnw.	15.4	
4:47	8,939	328.4	−39.0	0.94	------	------	nnw.	18.8	Adiabatic.
	9,000	325.6	−39.5	------	------	------	nnw.	19.8	
	10,000	281.4	−47.1	------	------	------	nnw.	19.6	
4:57	10,720	253.1	−52.6	0.76	------	------	nnw.	19.8	
	11,000	243.2	−52.9	------	------	------	nw.	21.3	
	12,000	209.1	−53.9	------	------	------	nnw.	27.0	
5:06	12,348	197.7	−54.3	0.10	------	------	nw.	26.8	Isothermal.
	13,000	179.0	−57.3	------	------	------	nnw.	26.6	
	14,000	153.3	−61.8	------	------	------	nnw.	19.8	
5:20	14,603	139.6	−64.5	0.45	------	------	nnw.	17.1	Base of stratosphere.
	15,000	131.0	−65.0	------	------	------	------	------	
5:30	15,936	112.9	−66.2	0.13	------	------	------	------	
	16,000	112.0	−65.9	------	------	------	------	------	
	17,000	96.0	−63.6	------	------	------	------	------	
	18,000	81.8	−61.1	------	------	------	------	------	
5:52	18,202	78.7	−60.6	−0.25	------	------	------	------	

TABLE 2.—*Tabulated data*—Continued

OCTOBER 28, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	*M.*	*Mb.*	°*C.*		*P. ct.*	*Mb.*		*M. p. s.*	
4:03	141	999.3	28.2		33	12.63	ssw.	5.4	4 Ci. WNW.
	250		27.2				ssw.	6.0	
	500	959.8	24.8				s.	7.1	Clear until 4 p. m.
	750		22.5				s.	7.6	
	1,000	905.9	20.1				sse.	7.6	
4:06	1,181	887.0	18.4	0.94			sse.	7.4	Adiabatic.
	1,250		17.7				sse.	7.4	
	1,500	854.8	15.1				s.	6.8	
	2,000	805.0	10.0				s.	7.4	
4:10	2,034	801.7	9.7	1.02			s.	7.6	Superadiabatic.
4:11	2,331	773.5	9.1	0.20			s.	9.0	
	2,500	758.0	8.1				s.	9.8	
	3,000	713.3	5.1				s.	10.0	
	3,500	671.0	2.0				s.	9.6	
4:16	3,652	658.3	1.1	0.61			s.	8.2	
	4,000	630.5	0.5				ssw.	3.9	
4:19	4,194	615.3	0.1	0.18			sw.	3.2	
	4,500	592.4	−1.9				wsw.	3.2	
4:20	4,679	579.3	−3.0	0.64			wsw.	3.4	
	5,000	556.7	−3.6				wsw.	2.9	
4:22	5,203	542.5	−4.0	0.19			wnw.	2.6	
	6,000	490.2	−9.8				w.	5.8	
4:27	6,585	454.4	−14.0	0.72			w.	4.3	
	7,000	430.0	−17.6				w.	3.6	
4:32	7,605	396.4	−22.9	0.87			wsw.	4.2	
	8,000	376.2	−26.5				wsw.	4.8	
4:36	8,610	345.6	−32.1	0.92			w.	3.8	Adiabatic.

OCTOBER 30, 1927

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
3:51	141	995.6	19.6		78	17.80	wnw.	11.6	8 A. St., SW.; 2 St. Cu.; NW (?).
	250		18.9						

TABLE 2.—*Tabulated data*—Continued.

OCTOBER 30, 1927—Continued

Time 90th mer.	Altitude, M. S. L.	Pressure	Temperature	Δt / 100 m.	Humidity: Relative	Humidity: Vapor pressure	Wind: Direction	Wind: Velocity	Remarks
P. m.	*M.*	*Mb.*	°*C.*		*P. ct.*	*Mb.*		*M. p. s.*	
3:15	500	954.8	17.3						Clear to 10 a., then cloudy to 6 p.
3:53	564	947.8	16.9	0.64					
	750		16.9						
3:54	940	907.0	16.9	0.00					Isothermal.
	1,000	900.8	16.5						
	1,250		14.8						Thunder first heard at 3:05 p.; last heard DNp. R. B. 3:18 p. E. DNa. 31 st.
	1,500	849.5	13.2						
	2,000	800.0	9.8						
4:00	2,125	787.7	9.0	0.67					
	2,500	752.0	6.0						
	3,000	707.7	2.0						
4:05	3,326	680.1	−0.6	0.80					
	3,500	665.9	−1.5						
	4,000	626.0	−4.0						
	4,500	587.4	−6.6						
4:10	4,823	563.1	−8.2	0.51					
	5,000	550.3	−8.9						
4:14	5,699	502.8	−11.7	0.40					
	6,000	483.9	−14.3						
	7,000	424.4	−22.8						
4:23	7,532	393.8	−27.4	0.86					
	8,000	368.9	−31.2						
	9,000	320.6	−39.1						
4:32	9,152	314.0	−40.3	0.80					
	10,000	279.3	−47.1						
	11,000	241.3	−55.1						
4:44	11,853	209.5	−62.0	0.80					Base of stratosphere.
	12,000	204.9	−61.7						
	13,000	175.0	−59.6						
4:56	13,636	158.9	−58.2	−0.21					
	14,000	150.4	−59.6						
	15,000	128.2	−63.4						
5:06	15,019	127.9	−63.5	0.38					

THE PASSING OF SIGNAL SERVICE, WEATHER BUREAU ELECTRIC TELEGRAPH AND CABLE SYSTEMS

ALFRED J. HENRY

In Weather Bureau Topics and Personnel for May, 1929, the following paragraph appears:

> The WEATHER BUREAU'S telegraph lines between Cape Henry, Va., and Hatteras, N. C., and between Port Angeles and Tatoosh Island, Wash., the short telegraph line between North Head and Fort Canby, Wash., and the telephone cable between Beaver Island and Charlevoix, Mich., will be transferred to the Coast Guard at the termination of June 30, 1929.

The above order marks the concluding chapter of the period of construction, ownership, and operation by the Signal Service and its successor, the WEATHER BUREAU, of electric telegraph lines and submarine cables for the purpose of obtaining weather reports from and issuing storm warnings to isolated points in various parts of the United States. A brief history of this special activity is presented in the following paragraphs:

In the early seventies the newly organized Signal Service of the Army, having been commissioned by Congress to organize a storm reporting and warning service for the benefit of commerce and navigation, was confronted with the problem of finding ways and means of reaching places not already linked up with any of the existing commercial telegraph or telephone systems. It should also be kept in mind that the Signal Service was a unit in the regular Military Establishment of the country and that one of its functions as such was to provide and maintain prompt communication between the frontier military posts of the Southwest and West with centers of trade and commerce and the War Department in Washington.

The problem of collecting and distributing meteorological information was solved by the organization in 1871 of the circuit system whereby the Western Union Telegraph Co. set aside certain trunk lines connecting the larger cities of the territory east of the Rocky Mountains with Washington, D. C., for the exclusive use of the Weather Service for such time as was required each day.

The establishment of military telegraph lines connecting military posts with the then outposts of civilization was based on the necessity of protecting frontier settlements from the outbreaks of hostile Indians and lawless men. In the early seventies the frontiers were found in the present States of Arizona, New Mexico, Texas, the Dakotas, Montana, Colorado, Wyoming, Idaho, and Washington. In each of these States telegraph lines connecting military posts with each other and the outside world were constructed and operated by the Army Signal Service. At many of the posts a regularly instructed Signal Service man was in charge. It was his duty, moreover, to make at least three meteorological observations daily and telegraph them to the Washington office. At the peak of the period of military telegraph-line construction there were as many as 111 military telegraph stations in operation and at 68 of them full meteorological observations were made and telegraphed daily.

The eastern seaboard of the United States constituted a frontier of a different character, viz, that of isolation, except at a very few points, as regards communication by the electric telegraph; it was moreover, subject to severe and dangerous storms during which the perils of naviga-

tion were greatly increased. In the early seventies the necessity of linking the coastal stretches with the commercial telegraph systems of the country was an outstanding problem for the Army Signal Service. A beginning was made in New Jersey where the first unit of what was for many years known as the "sea coast" line was constructed between Seaville and Pecks Beach, N. J., a stretch of but 10 miles. Immediate steps then were taken to construct a line along the beach of the New Jersey coast from Sandy Hook to Cape May Point and later to extend that line to Smithville, N. C. The line was finished in about a year and functioned successfully for many years; the section from Cape Henry to Hatteras, N. C., now transferred to the Coast Guard was a part of the original construction. The line was operated directly from the signal office in Washington, D. C., and had for its purpose the display of storm warnings in the interest of coastwise as well as of across-seas traffic. Another factor in its use was the succor of vessels in danger of foundering or in distress. Communication between ship and shore was had by means of the international signal flags and by visual signalling in the rare cases when a Signal Service man boarded a vessel in distress and wished to communicate with shore.

Military telegraph lines in the interior, as from time to time, authorized by Congress were for the most part constructed by troops detailed for that purpose. Among the first, if not the very first line so constructed, was one joining San Diego, Calif., by way of Fort Yuma and Maricopa Wells, Ariz., with Prescott and Tucson. This construction was followed by a survey and preliminary work looking to the building of lines connecting military posts in Texas, of which at that time there were 10 or 12. Some of them were along the Texas-Mexico boundary, one was in the Texas Panhandle and others were more or less distant from the advance posts of settlement. To connect these points and other places along the border required a greater outlay of time and labor than had hitherto been expended in any single State.

Concurrently with the activity in Texas, building new lines and extending those already built both in Arizona and New Mexico also in the far Northwest was being carried on.

The longest stretch of line when single units were joined together was that extending from San Diego, Calif., to Denison, Tex., as an eastern terminal. The present writer, when stationed at the last-named point in 1879, well remembers making a number of attempts to work with San Diego, but without success due, no doubt, to the poor insulation of the line in places. Ordinarily the attempt to work long stretches of the military lines as a single circuit was not made. The Texas lines of a total length of more than 1,500 miles were operated as a single circuit three times daily in the collection of meteorological reports from the stations on those lines. At other times they were operated as two or three separate circuits.

Several causes were responsible for the gradually dwindling mileage of the military telegraph lines from its peak of 5,114 miles in 1882 to 1,025 miles in 1891. These causes, named in the order of their importance were, (1) appeals to Congress for increased appropriations for their maintenance were only partially realized, (2) the custom of detailing enlisted men from the Regular Army as operators and linesmen failed in 1883, (3) the abandonment of military posts naturally resulted in the sale or dismantling of the line if local interests were not sufficiently great to warrant its maintenance as a private venture.

In 1883, the year after the peak was reached 2,450 miles of line were sold or abandoned and eight years later when the meterological activities of the Army Signal Service were transferred to the newly created Weather Bureau in the Department of Agriculture but 1,025 miles of the original 5,114 remained. Only those sections that were vital to the meteorological service were continued in use by the Weather Bureau. The new construction by that bureau amounted to a total of 270 miles of land lines and submarine cables; that mileage plus the 629 miles inherited from the Signal Corps makes a total of 899 miles all of which has now been disposed of either by sale or transfer as noted in the beginning of this article.

EFFECT OF CLOUDS ON THE SURFACE TEMPERATURE

By W. J. Humphreys

Obviously the radiation emitted by and from any portion, large or small, of the surface of the earth tends to come into equilibrium with the radiation simultaneously absorbed by the same surface. Clearly, too, this exchange, though generally equal only twice in the course of a day and night, would, on the average, balance perfectly (neglecting the minute supply of heat from the interior of the earth) if there were no conduction to and from the atmosphere, nor vertical or horizontal motion—convection and advection—of the air or the oceans, nor evaporation or condensation. But all these things do occur and they greatly disturb the radiation balance. However, they are roughly the same whether the sky be clear or cloudy, and therefore may be disregarded in computing a first approximation to the effect of clouds on the surface temperature.

The rate of emission per unit projected, or minimum inclosing, area is a function of the material and mechanical condition, rough or smooth, of the surface (reentrant angles producing a closer approach to the full radiation) its temperature (directly proportional, nearly, to the fourth power of the absolute temperature), and to the barometric pressure, varying directly as the square of the refractive index of the adjacent air. This latter effect is negligible, since the refractive index in question differs very little from unity. The rate of this radiation does not, however, depend at all on the state of the sky, such as clear or cloudy.

On the other hand, the rate of absorption by the given radiating surface does depend, and very greatly, on the state of the sky owing to the consequent large variations in the amount of incident radiation that might be absorbed. It also, like emission, is a function of the material and condition of the surface and of the barometric pressure.

In general, except as prevented by winds, convection and evaporation, the temperature of the surface tends rapidly to become such that emission is equal to absorption. Furthermore, the greater the rate of incident radiation the greater, in substantially the same ratio, the rate of absorption and the higher the surface temperature.

Let—

S = the net radiation received (incoming less outgoing) per unit horizontal area during a clear night.

S' = the net radiation similarly received from sun and during a clear day.

C = the net radiation received per similar area from a low cloud canopy by night.

C' = the net radiation received per like area from a low cloud covering by day.

Evidently, then, if, as assumed, we may neglect everything but radiation and absorption, and consider the coefficient of absorption to be the same whether the sky be clear or clouded, the effect of a sheet of clouds is to lower the surface temperature, to leave it unchanged, or to raise it, according as $S+S'$ is greater than, equal to, or less than $C+C'$.

From observations by Kimball,[1] we know that throughout the night, and for the latitude of Washington, D. C., the net outgoing radiation is, when the sky is clear, 0.15 calories, roughly, per minute per horizontal square centimeter, and 0.05 calories when the sky is covered with clouds.

Furthermore, from observations, $S=5\ C$, roughly. Finally, let X be the number of minutes from sunset to sunrise.

At Washington, D. C., the total radiation received per square centimeter horizontal surface during a clear day is,[2] in June, 732 calories, and in December, 241 calories. That is, numerically, in June $S'=732$, $C'=146$, and in December, $S'=241$, $C'=48$. In June, $X=600$, while in December, $X=880$. Hence in June, $S=-90$, $C=-30$, and in December, $S=-132$, $C=-44$. Thus, at Washington, in June, $S+S'=642$ and $C+C'=116$.

[1] MONTHLY WEATHER REVIEW, 46, p. 57, 1918.

[2] Marvin and Kimball, Journal of the Franklin Institute, 202, p. 302, 1926.

Therefore a cloud canopy, day and night, at Washington, D. C., would lower the temperature in June.

In December, $S+S'=109$, $C+C'=4$. Hence in December also a continuous cloud canopy would lower the temperature at this locality. At a somewhat higher latitude, however, probably around 50°, the cloud canopy would not change the temperature at this season, while at a still higher latitude it would raise the temperature.

As stated above, evaporation and condensation, and the circulation of air and water are very effective as distributors of heat. Therefore the boundary along which a cloud canopy would have no effect on the surface temperature is distorted irregularly in time and place by all these phenomena, as well as more or less uniformly shifted with the course of the seasons. Only continuous and direct observations can give us full information as to the places and times of the warming and the cooling of the surface of the earth—the places of net gain and net loss of heat by all processes combined. However, it does seem practically certain that a continuous cloud canopy over the entire earth would materially lower its average temperature. It would raise the temperature of polar and high latitude (beyond latitude 50°, roughly) winters, and lower the temperature at nearly all other times and places.

This qualitative result is, of course, unsatisfactory, but that appears to be all we can obtain at present with assurance.

WINTER OF 1928-29 IN EUROPE

By W. R. STEVENS

[Weather Bureau, Washington, June, 1929]

The past winter has been one of the most severe that Europe has experienced since the inception of systematic meteorological observations. In Berlin, for example, the mean winter temperature was the lowest of record, with but one exception, 1829-30. There was but one day from December 8, 1928, to March 7, 1929, when the temperature was not below freezing. December was about 2° F. below normal, January 6° F. below, and February 20° F. below. Since 1851 there have been but six winters with all three months below normal. February, 1929, was the coldest since meteorological observations were begun at Berlin in 1720; the temperature of −13° F. observed on the morning of February 11, is the lowest of record. Lowest temperatures of record were also observed at Hamburg (−6° F.), Hannover (−13° F.), Frankfort on the Main (−7° F.), Frankfort on the Oder (−24° F.), Dresden (−18° F.), Leipzig (−17° F.), Breslau (−26° F.) Munich (−25° F.), and Vienna (−15° F.), the latter being the lowest since observations were begun in 1775.

During January pressure was above normal over western Europe and greatly above in the region of Iceland, Isafjord being 0.72 inch above, while Horta was 0.33 inch below. One of the most unusual features in January, 1929, was the fact that pressure averaged higher over Iceland than over Horta.

In February also the pressure distribution was very abnormal. Iceland and Horta returned to normal, or slightly above, but over Scandinavia the departures were as much as +0.60 inch, while departures in southern Europe were negative.

During the first few days of January a LOW of considerable intensity was central over the Mediterranean, which was accompanied by heavy rains and resulted in the worst flood on the Tiber since February, 1915. Cold weather and heavy snows occurred during the first half of the month quite generally over Europe as far south as the Riviera. In central Europe the snows were so heavy that railway and telegraph communications were broken in several places, the ice on the Elbe above Hamburg was so thick that the river could be crossed on foot, skating was permitted on the lakes in the Bois de Boulogne in Paris on the 17th and 18th for the first time since 1917.

The most severe period lasted from approximately January 21 to February 21. For about a week previous to the beginning of this period a HIGH of great intensity had been building up over Siberia in the Provinces of Irkutsk and Yakutsk, and began gradually spreading to the westward. On the morning of January 21st, high pressure extended from Japan to western Europe with a crest of 31.39 inches at Bratski-Ostrog in the Province of Irkutsk, which had advanced to western Russia, Perm, 31.16 inches, by the 24th. Pressure fell over southern and central Europe, a LOW of considerable intensity developing over the Mediterranean by the 25th, which moved eastward and on the 31st was central over Limasol, Cyprus, 29.59 inches. This LOW was attended by heavy snows as far south as the Riviera and severe cold and violent storms in Jugoslavia. In the meantime pressure remained high in Russia and Siberia, Leningrad, 31.03 inches; Chita, Trans-Baikal Province, 31.30 inches. By the morning of February 4 the Leningrad HIGH had

moved southwestward to Czechoslovakia, Prague, 30.42 inches; and the LOW over the Mediterranean had remained practically stationary, but with a slight increase in intensity, and heavy snow and violent gales occurred in Constantinople. On the morning of the 3d snow was reported at Palermo, Sicily. Canals in Holland had frozen over. By February 8 the Mediterranean LOW had moved northeastward to Kustanai in the Province of Turgai where it rapidly dissipated; pressure increased over southern Europe and remained high in the Provinces of Yakutsk and Irkutsk, Bargusink and Bratski-Ostrog, 31 inches, with an extension to the northwest, Obdorsk, 30.74 inches. By the morning of the 11th, a LOW of considerable intensity had formed over the Mediterranean, Leghorn, Italy, 29.50 inches, and pressure had increased over northern Europe to 30.77 inches at Helsingfors. By the 12th, the Rhine, Lake Constance, parts of the Baltic, and the Elbe from Hamburg to Dresden were frozen. On the 15th ice floes were floating on the Grand Canal at Venice. High pressure in the north and low pressure in the south prevailed until the 23d of the month, when the high pressure finally gave way and cyclones were again permitted to take normal courses.

One of the most striking features during the period of January 21 to February 21 was the great preponderance of positive pressure departures over the Northern Hemisphere. During most of the period pressures were above normal over most of the continental areas, the largest departures occurring over Central Asia, where, except for the last few days, pressures were 0.20 inch to 0.90 inch above normal. Negative departures were confined for the most part to rather small areas in northern oceanic regions.

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WATERSPOUTS IN THE STRAIT OF MALACCA

The following description of several waterspouts observed in the Strait of Malacca was furnished to the Weather Bureau by Capt. F. G. Randall, master of the British steamship *Flowergate*, in a communication dated at Singapore, February, 1929:

On the morning of the 17th of February, in the Malacca Strait, in latitude 4° 28′ N., longitude 98° 51′ E., at 10:40 a. m., local mean time, observed waterspouts forming on the starboard bow, about 15 miles distant. The atmospheric conditions at the time were a southeast wind, force 2, sea 1, with heavy, ragged cumulo-nimbus clouds, the approximate height of which by sextant was 2,500 feet, with a range of about 8 points of the compass. Cirrus clouds were observed in the zenith.

Two large and four small waterspouts were observed forming simultaneously, the average length of the well-defined trunks being 1,200 feet; sketch attached. (See fig. 1.) Five minutes after their formation a circular disturbance of the sea beneath the spouts was also observed, but owing to its distance from the vessel, no definite statement can be made as to its nature.

At 12:50 p. m., local mean time, on the same day, in latitude 4° 13′ N., longitude 99° 16′ E., a well-defined waterspout was observed about 1 point on the port bow, distant 5 miles. A black trunk was observed reaching to within 20 feet of the sea, and a conical disturbance of fierce intensity was seen immediately beneath the trunk. The water was plainly to be seen ascending in a spiral, but we were unable to tell the period of the revolution. This spout lasted from 0:50 p. m. to 1:15 p. m., when it dispersed. (Fig. 2.)

At 1:20 p. m. a circular distortion of the sea, like water foaming over an area of about 400 feet, was observed about 1 mile distant on the starboard beam. Five minutes later a black trunk was observed descending from the cloud to meet the disturbance on the sea. The direction of rotation was anticlockwise and at a good speed. The water disturbance resolved itself into a conical shape, about 100 feet high, where the spiral became dark. The approximate height of the trunk was observed to be 1,366 feet, by sextant, with an approximate circumference of 100 feet. This spout commenced at 1:20 p. m. and dispersed of its own accord at 1:35 p. m. After the sea disturbance had ceased, the ragged, truncated cone was seen to be still revolving in the cloud, which slowly traveled in a northwesterly direction. After the dispersing of the spout a few heavy drops of rain fell. The atmospheric conditions at time of observation were a southeast wind, force 2, sea 1, and heavy cumulo-nimbus of an approximate height of 2,000 feet.

WATERSPOUT ON HILLSBOROUGH BAY, TAMPA, FLA., APRIL 2, 1929

By WILLIS E. HURD

The information contained in this description of a waterspout that formed in Hillsborough Bay on April 2, 1929, was furnished by Mr. George V. Fish, an assistant at the Tampa Weather Bureau Station. At 6 p. m. of that date Mr. Fish and two companions were fishing about a mile from the western shore of the bay, which is here about 5 miles wide, and 7 miles from the business section of the city. (See fig. 3.) At this time a threatening cumulonimbus cloud appeared over the eastern shore and the wind freshened. The fishermen began rowing toward their pier on the western shore, and while thus engaged observed a whirl of spray rising on the water almost underneath the spreading cloud. Mr. Fish, believing a waterspout was forming, the rowers made greater haste toward land. Shortly a "gray funnel twisted out of the front of the cloud and down from the center of it dropped a long gray tail as another rose up out of the center of the spray to meet it." They joined in midair producing a slanting spout, the base of which was carried by the wind in advance of the cloud. It was estimated to be about 1,500 feet long, and the vertical height from the water to the cloud base, about 1,200 feet. The spout was funnel-shaped at top and bottom, the base being about 40 feet in diameter at the point several feet above water where it emerged from the ring of spray. The diameter midway was approximately 10 feet. The whirling direction of both spray and spout was distinctly clockwise.

While the waterspout was taking a southwesterly course toward the center of the bay, the Collier Line steamer *City of Tampa* was proceeding southward on a line that seemed likely to intercept the path of the phenomenon. As the two neared each other, Captain Borden reduced the steamer's speed to permit his passengers to view the spout at close range. They were so near at one time that it was necessary to hold hats and fold the deck chairs, owing to the stiffening wind, and the captain, becoming fearful of an actual contact, fired at the spout with the live-saving gun, whereupon the spiral broke and faded though the ring of surface spray whirled on past the steamer. Shortly afterward the spout reformed and "after meandering back across the vessel's bow a second time, settled on a course in the general direction of Tampa Bay and the open gulf."

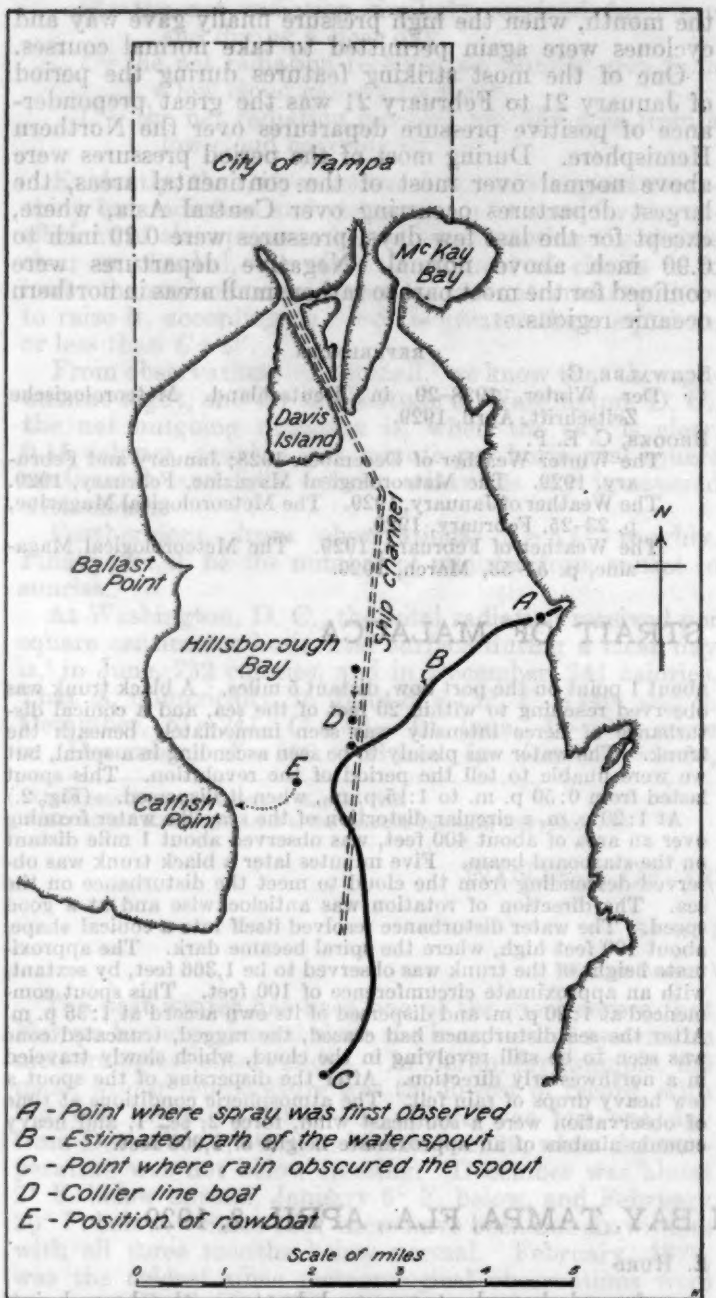

FIGURE 3.—Hillsborough Bay, Tampa, Fla., showing path of the waterspout of April 2, 1929, the course of the steamship *City of Tampa*, and the position of the observer. From drawing by Mr. George V. Fish, of the Tampa Weather Bureau Station

It now remained under observation until a rainstorm, coming between it and the steamer, obliterated it from further view.

"A tremendous roaring accompanied the spout," said Mr. Fish, although he did not hear it, this information being later given to him by Captain Borden. "A solid cone of water rose up in the center of the spray to a height of from 15 to 18 feet. Around this cone the spray was being whirled, the rays from the setting sun producing on it all the colors of the rainbow."

The following generalizations were arrived at by the observers:

(1) The whirl on the water was visible before the funnel appeared in the cloud and before any whirling motion in the cloud was observed.

(2) The spout dropping from the cloud and the one rising from the spray developed simultaneously and met in midair.

(3) The forces at work were so strong that the pressure at the center was lowered to a point whereby the water was pressed up to a height of 15 or 18 feet, and mud and seaweed were drawn up from the bottom of the bay through 15 feet of water.

(4) The path of mud left by the spout is the best check on the diameter of the spiral at the base. The path on the water was estimated to be about 50 feet wide.

(5) The waterspout preceded the rain by from 3 to 5 miles. After the base spray passed the bow of his ship, Captain Borden steamed directly under the great funnel in the cloud to observe the mighty whirling. All was in brilliant sunshine at the time.

(6) The water spray was drawn so rapidly to the cloud that the spiral upward movement was plainly evident.

(7) The circulation on the water was clockwise.

(8) No accurate check on the duration of the spout is obtainable, since it was continuing unabated when the rain hid it from view.

Remarking upon the frequency of the phenomenon in Hillsborough Bay, the man from whom Mr. Fish rented the boat "said that he had seen seven waterspouts during one thundershower the previous summer."

Mr. Fish mentioned "another experience had by Captain Borden some years ago with a sailing vessel in a waterspout. It came upon him rapidly, and while he made all haste to lower and secure his canvas, he was unable to complete the work before the waterspout engulfed the ship. It stripped his booms, breaking some, and wrecked other parts of his deck gear, as the vessel pitched and spun about, finally to emerge deluged with water."

EVIDENCE OF PROLONGED DROUGHTS ON THE COLUMBIA PLATEAU PRIOR TO WHITE SETTLEMENT

By OTIS W. FREEMAN

Ellsworth Huntington, A. E. Douglass, and others have presented much evidence favoring wet and dry years alternating over centuries of time in the southwestern United States. The following note presents proof of prolonged drought in the past on the Columbia Plateau in the Northwest.

A large number of lakes exist on the lava plateau southwest of Spokane. These occupy basins in channels of the "scablands." According to J. H. Bretz, of the University of Chicago, a great flood was produced by the very rapid melting of a continental glacier. The swift torrents scoured away the surface soil and the resulting bare basaltic bedrock is locally called "scabrock." The numerous interlaced channels once filled by flood waters are called "scablands." Basins eroded by the flood are often occupied by lakes which vary in size from mere ponds in potholes to deep, rock walled lakes 10 miles in length.

Most of the lakes have no visible outlet. Many are highly alkaline, especially in the drier sections of the Columbia Baisn. Typically the lakes occupy elongated basins with steep cliffs descending abruptly into deep, rock water, but in places along the shores of the lakes, particularly at their heads, material has been deposited, making swamp or shallow water. Decreased rainfall causes the water level to sink and trees can grow on the

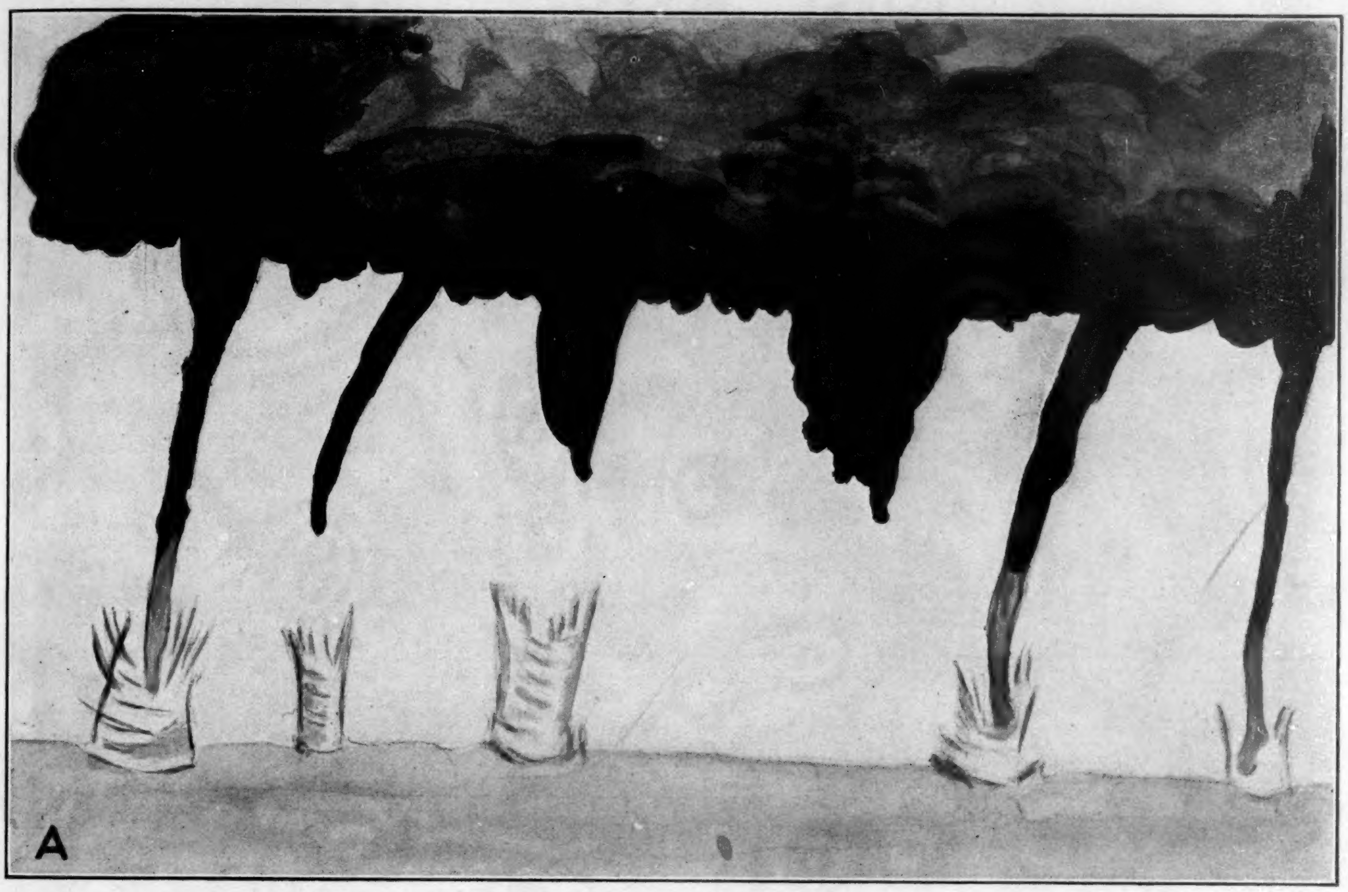

FIGURE 1.—Simultaneous waterspouts observed in Malacca Strait, February 17, 1929. From drawing made on board the British steamship *Flowergate*

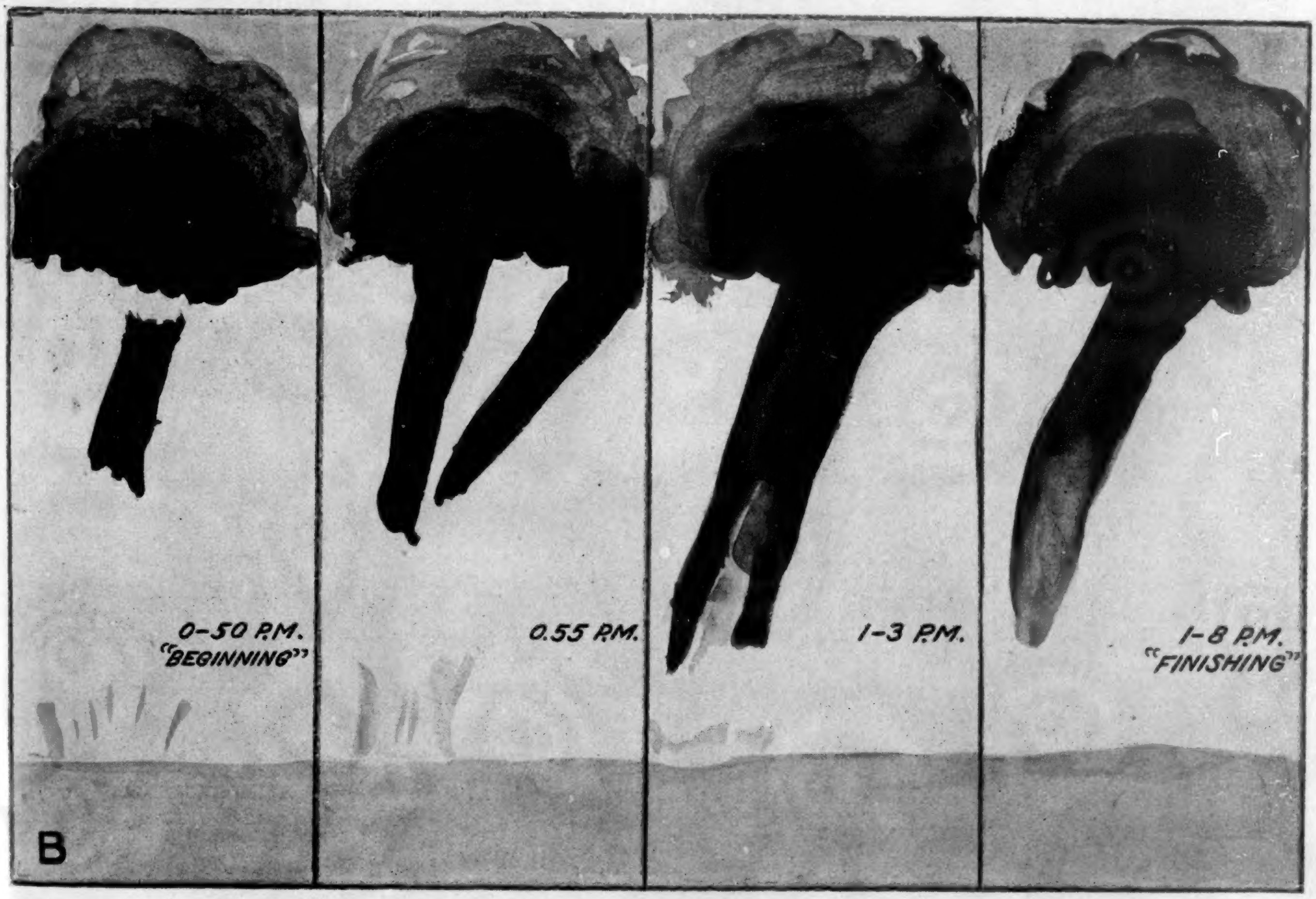

FIGURE 2.—Successive appearances, from 12.50 p. m. to 1.08 p. m., of a waterspout observed in Malacca Strait, February 17, 1929. From drawing made on board the British steamer *Flowergate*

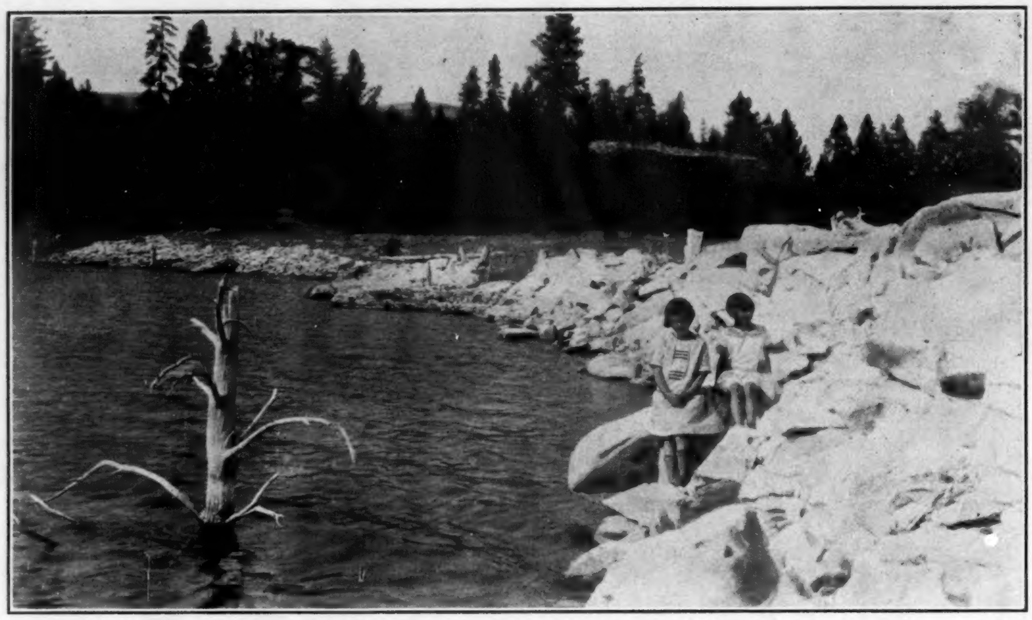

FIGURE 1.—Shore of Granite Lake, Spokane County, in 1926. The lake level was the lowest since white settlement about 60 years ago, yet stumps 1 to 2 feet in diameter, with over 100 rings of growth were standing in the lake. The trees are yellow pine which grow on well-drained soil. A further drop of 5 to 10 feet in lake level would be necessary for the pines to again grow in this situation. The climate must have been decidedly drier for over a century to have produced such low-water level

FIGURE 2.—Shore line of Silver Lake, Spokane County, in 1926. Pines and willows have migrated to the lower shore line which is about 40 feet below that in 1915 before 10 years of drought began. Part of the drop in Silver Lake resulted from pumping water for irrigation and water supply of the city of Medical Lake. The men are standing on deposits of calcareous tufa

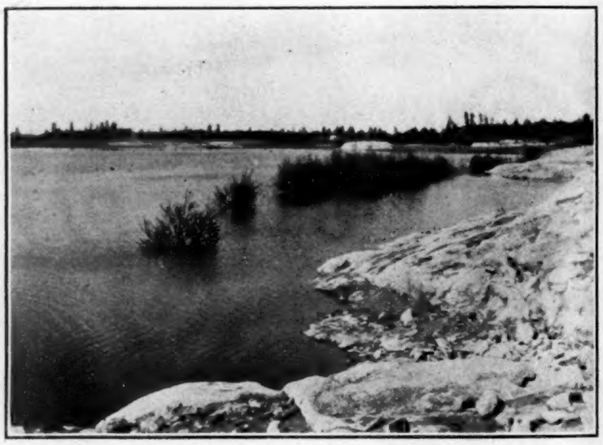

FIGURE 3.—Shore of Silver Lake, Spokane County, in 1928. Willows killed by rising lake water. The level of the lake rose in part because pumping from it for irrigation and other uses ceased in 1926, but more because of heavy rainfall in 1927–28. The change of level shown in these photographs is greater than for other lakes because of the pumping, but all lakes in the "scablands" were at low levels in 1926 from drought and at high levels in 1928 because of abundant rainfall. Silver Lake rose nearly 20 feet in two years. Other lakes rose about one-half or one-third of this amount

FIGURE 4.—Shore of Granite Lake, summer of 1926. Note the stumps that had been long under water exposed by the shrinking of the lake resulting from more than a decade of dry years. Some of these stumps were again surrounded by water in 1928, by the rising lake water, the result of heavy rains and snows. In 1889, according to George Craig, of Cheney, the large rock at the left of the view was an island whose top was just above the water surface. The point at which the dead pines decayed and broke off leaving the present stumps would be at about the level of the lake in 1889. Wood, of course, decays most readily at the point where it is alternately wet and dry. Young pines are beginning to invade the mud flat beyond the stumps where the drainage is better. A wetter cycle in the future would drown the invaders and the story told by the stumps would be repeated

newly exposed land. Increased rainfall causes the lakes to rise and the trees are killed.

Stumps of dead trees were found by the writer standing in Granite Lake, Williams Lake, Medical Lake, Badger Lake, and many other lakes southwest of Spokane, during the summers of 1926 and 1927, when after 10 years of deficient rainfall the level of the lakes was the lowest known since the white man settled the country. Rings of growth proved some of the trees lived over a century, during such a prolonged drought period that lake levels were below anything known to-day. Since most lakes on the Columbia Plateau, except where the rainfall was too low for trees to have ever grown, contain stumps of trees killed by rising water; it is proof of a widespread drought period lasting over a century. The phenomenon being widespread can not be accounted for by a local cause that might temporarily have affected the level of one lake alone.

The time of occurrence of the prolonged drought, and whether more than one such period happened has not been determined.

Additional evidence for long drought in historic times comes from eastern Oregon. In the summer of 1926 Goose Lake, Malheur, and Harney Lakes almost disappeared after several exceptionally dry years. In the dried up lake bed well defined wagon ruts were found. It is supposed these were made by the wagon of some pioneer in the decade after 1840, as the floor of the lake had never been exposed since the region was permanently settled.

AGRO-CLIMATIC CONDITIONS IN RUSSIA[1]

By Prof. W. v. POLETIKA

[Berlin, Germany, 1928]

On account of the uniformity and enormous extent of the belt of the Russian plain and the almost complete absence of mountains the climate is the chief factor in landscape formation. With the flat conditions of Russia this develops in zone form mainly in the direction of latitude and is subject to the influence of solar and Atlantic climatic factors.

The orderly series of latitudinal climatic zones is accompanied by a corresponding arrangement of territories in which soil and vegetation on the one hand and sanitary, economic, and social conditions on the other are the same.

Almost one quarter of European Russia is waste land, whose geographic features, nature of soil, and character of climate—marked lack of warmth in the north and lack of water in the south—are altogether incompatible with any form culture; hence the presence of tundras in the north and the desert belt in the south are readily explained.

The climate of the flat part of Russia either shows the same characteristics detrimental to agriculture and necessitates recourse to primitive forms of farming in the northern Tayga (swampy forest) and in the southern steppes, or then it considerably hampers farming, as in almost all of the remaining parts of the middle forest and steppe regions, which comprise the greatest and best part of the arable surface of Russia.

The climatic extremes of the farming region are explained for the most part by extreme continentality and can be summarized as follows: (*a*) Marked change in temperature from summer to winter and from day to night; (*b*) in general, long-continued, severe winter, especially in eastern Siberia, and hot summer in the south; (*c*) scant amount of snow in Siberia and great extent of perpetually frozen ground, (*d*) lack of precipitation in southern and southeastern Europe, the region of most fertile soil; (*e*) dissimilarity of rainfall régime in the whole farming area, and lack of rain in the spring and early summer (even in the region of the Atlantic wedge of maximum precipitation of eastern Europe), which injures forage plants, clover, and alfalfa, so necessary in crop rotation; (*f*) extraordinarily short growing season of three to five months; and (*g*) droughts, hot winds, dust clouds, heavy downpours and hail in the south and southwest, and severe night frost over extended areas.

The climatic extremes prevent the permanent colonization of two-thirds of the Russian region and impose upon the cultivated vegetation the stamp of a type of weather very fickle and productive of small yields. Hence expenditures on intensive agriculture do not pay and extensive forms of farming are not supported.

Although it permits farming in the forest belt and in the steppes, the climate of Russia is on the whole not favorable to agricultural development, especially in comparison with western Europe, India, and China.

The climatic conditions make farming but little profitable in the greatest part of Russia; they hardly permit an extension of the farming area and make unattainable the raising of yields to the type found in western Europe, where the harvests are two to three times as great as those in Russia before the World War. Under present conditions on 96 per cent of small rural farms it is not possible to count upon farming as the sole factor in the commercial, economic, and social development of Russia.

For the further advance of Russia and for the easing of the struggle of man against natural conditions there must be a change to diversified farming of intensive type and a development of household industries.

Also, there must be development of mining in order that soil fertility may be renewed and introduction of labor-saving machinery, without which the betterment of the agricultural system is impossible.

[1] Agroklimatische Verhältnisse Russlands. Der Kulturtechniker, Zeitschrift der Deutschen Kulturtechnischen Gesellschaft. XXXI Jahrg. Heft Nr. 6 Breslau. 1928. Translation of conclusions.—*W. W. Reed.*

THE TORNADOES OF MAY 2 IN VIRGINIA

By H. A. FRISE

A series of tornadoes, visiting no fewer than six separate localities within the State on the same afternoon, is without precedent so far as records of this class of storms in Virginia show. Such was the misfortune to befall the mountain districts of the State on May 2.

That an unusual weather control existed seems evident. The 8 a. m. weather map for that date shows that the distribution of barometric pressure over the eastern United States was particularly favorable for the development of this class of storms. The central area of an energetic depression that embraced the eastern United States was over southern Indiana moving rapidly northeastward. The tornadoes that developed over Virginia were therefore about 300 miles southeast from the central area of the cyclone. In the southeast quadrant, temperatures were rather high, but not as high as might have been the case with clear skies.

Two of the localities visited by tornadoes were west of the Blue Ridge. Rye cove, in Scott County, about 9 miles northwest of Gate City, the county seat, is located on a plateau of about 1,500 feet elevation between two ridges that rise 500 feet above the plateau. These ridges trend northeast-southwest and are about 2 miles distant from the village.

The valley of Cowpasture River in upper Alleghany and lower Bath Counties also lies between two ridges, Beards Mountain and Rough Mountain, that rise to 2,500 feet, the valley being about 1,500 feet. The other localities are in the northern part of the State, east of the Blue Ridge and at lower elevations.

Woodville, Rappahannock County, is a village between two ridges about a mile distant that rise around 500 feet above the valley in which the village is situated. The Blue Ridge, 10 miles to the west, rises to 3,000 feet or more. Woodville is about 16 miles east-southeast from Luray.

Lagrange is in Culpeper County about 8 miles east-southeast from Culpeper and 20 miles southeast of Woodville.

Weaversville, near Catlett, Fauquier County, is about 8 miles southeast of Warrenton. These last two communities are not as near mountain ranges as are the first three.

Hamilton, in Loudoun County, is about 8 miles east of the Blue Ridge, which in that part of the State is around 1,500 feet elevation. This vicinity is about 30 miles northwest from Washington, D. C., and 6 miles northwest of Leesburg, the county seat.

An examination of the weather maps of May 2 shows that the rate of translation of the cyclonic area was a little more than 40 miles per hour, southwest to northeast. Assuming that local disturbances within the influence of the cyclone were carried along at about the same rate, it may have been, although it is rather improbable, that Rye Cove and the Cowpasture Valley were visited by the same tornado, 2 p. m. at Rye Cove and about 4 hours later in lower Bath County, about 170 miles distant. The Valley of Virginia is rather closely settled and it would be remarkable if this storm should have passed over 170 miles without detection. Woodville was struck about 3:30 p. m., only an hour and a half after the Rye Cove disaster and three hours before the storm occurred in Cowpasture Valley. These facts make it necessary to conclude that another tornado developed east of the Blue Ridge. There are indications, however, that the Woodville storm was identical with that which visited the community north of Hamilton in Loudoun County. The storm at Lagrange and at Weaversville, near Catlett, occurred four and a half or five hours later than that at Woodville. There are conflicting statements as to the time at Lagrange, but it is believed that the storm passed directly from Lagrange to Weaversville.

It therefore seems certain that three[1] separate tornadoes occurred. Each resulted in the death of one or more persons with serious loss of property as well as live-stock killed or maimed. Of the property destroyed there were 4 school buildings, 1 at Rye Cove, 2 in Cowpasture Valley and 1 at Woodville. At Rye Cove the reassembly of school from the noon recess had just been called by the principal of the school, Mr. A. S. Noblin, who is quoted in a news dispatch as follows:

> It was raining at the time, 12:55 p. m. central time, and classes were still recessed for noon. About 25 children were in the building, the remainder being on the playground. I was walking down the hall when I saw what looked like a whirlwind coming up the hollow. Trees were swaying and as the whirlwind neared the building it became a black cloud. It struck the building and I believe I yelled. The next thing I remember I was standing knee-deep in a pond 75 feet from where the building had stood. I was badly shaken up and frightened and surprised that I was able to wade out of the water. Bodies of children were scattered over a wide radius.

Twelve children and one teacher were killed outright and 50 injured, many seriously. The fact that only part of the total assembly had entered the building at the time probably accounts for so many escaping death. The building was of oak frame, well constructed, 2-story, and contained 10 classrooms and an assembly room. It was completely demolished and scattered. Mr. I. M. Johnson who viewed the storm and the destruction of the school from a near-by hillside, saw two clouds rush together about a mile down the valley and seemed to form the funnel cloud that reached the school building a few moments later. The school building disappeared before his eyes and a veritable hail of boards and débris followed. The tornado continued on a few miles, but so far as reports indicate, no other settled communities were in its path in that part of the State. Doctor Hart, State superintendent of schools, who visited the scene, stated that it is doubtful if any form of structure would have withstood the storm, but that the hazard to life might be less in a 1 story building in such cases. There were several other buildings destroyed in this village, but the only lives lost were in the school. The estimated loss in property was $100,000.

At Woodville the tornado was seen when about a mile to the south of the village where a dwelling was moved on its foundation but not damaged otherwise. A few moments later it struck the village and destroyed most of the buildings in it, among them the school building, and while about half of the number of pupils were injured with two of the teachers, only one was killed, crushed in the débris. This was the only fatality at Woodville. The storm continued on through the county, causing extensive damage to farm property. Mr. W. T. Yancey of Woodville, says in regard to this storm:

[1] It is impossible to determine from the geographic position of the places visited by tornadoes whether or not there were three or twice that number of separate storms. Virginia being rather thickly settled it is reasonable to suppose that a tornado cloud even in the air would be seen and reported at more than a single point. The Woodville and Hamilton tornadoes may have been the same storm but there is more or less doubt as to the others being continuous between the places named.—Ed.

The first trace we have of this tornado was about a mile and a half south of the village of Woodville where it moved a large dwelling about an inch on its foundation. From that point it continued in a north-northeast direction dealing death and destruction in its path through the County of Rappahannock. There is not enough of the high school left intact to build a chicken coop. House and scholars all blown away and why all were not killed was a miracle. Some found unconscious 200 yards from the site of the building. Five are in the hospital.

The losses in the county have been estimated at $200,000.

In the valley of the Cowpasture River are several villages, among them Coronation and Sitlington, in lower Bath County. In these communities property losses were serious, and while a number of persons were injured, none were killed. The storm occurred in this section around 6 p. m., so there were no children in the school buildings at the time. Mr. E. J. Peters, who viewed what appeared to be the formation of the tornado, says that it appeared as if two strong winds met just below his place and formed one current of great velocity, destroying practically everything in its path. Buildings in the center of the path, which was from 250 to 800 yards in width, were destroyed, while those on the border were only partially destroyed. Mr. G. L. Schumaker, postmaster at Covington, followed the storm path for about 12 miles. He reports:

The storm continued about 17 miles. In some cases farmers lost all their property. One orchard, consisting of one hundred and fifty 21-year old apple trees belonging to J. W. White, was destroyed. At Mr. E. J. Peters' place, the roof of the house was taken off and the barn, in which his sister was milking a cow at the time of the storm, was lifted up and carried away. His sister was found some distance from where the barn had stood, under a floor of the barn, one edge of which was resting on a stone wall. She was not injured, nor were the six cows that were in the barn. Poultry houses and poultry were carried away. Some of the chickens were found at a distance, dead, and practically divested of feathers. The property losses in this valley were estimated at $75,000.

In the vicinity north of Hamilton, the storm path was about 200 yards wide and extended for about 2 miles. At one farm, the house, barn, and other smaller buildings were destroyed and a cow killed. The man and his wife were injured, but no deaths resulted in this section. At other places in this vicinity, damages were sustained to houses and barns and one large brick church. The total loss being estimated at $50,000.

The Lagrange-Weaversville tornado, which was the last in point of time, struck Lagrange around 7:30 or 8 o'clock. In this vicinity, two persons were killed when their house was destroyed. No details nor estimate as to property damage sustained in this vicinity was obtained, but to the northeast in Fauquier County, there was greater loss of life and more extensive property damage. Four persons were killed at Weaversville, and another probably fatally injured, but subsequent reports as to this have not been received. There were eight persons injured and sent to hospitals. Two residences were demolished, one a 14-room brick building, and four others greatly damaged. The storm seems to have extended about a mile farther. Rev. George W. Crabtree, of Catlett, has been quoted in a news dispatch, as follows:

I was in my house and heard a terrible roar like several trains. I looked out and saw black clouds swirling overhead. Trees were bent to the ground and the house rattled. It was about 7:30 p. m. A neighbor told me the cyclone had hit down the road and I drove to the scene. All lights were out and trees were across the road, making it difficult to drive. As I reached the place most severely struck by the storm, I saw houses that had been flattened, telephone wires all over the place and débris over a radius of several hundred yards. It was raining in torrents and the wind was still blowing hard. Then came the task of pulling the dead and injured from the ruins.

In addition to the persons killed, one herd of 15 cattle was destroyed, a few of the cattle remaining alive were killed later because of the nature of the injuries. No estimate of the property losses in this community was secured, but it seems probable that they were equal to or greater than those in the vicinity of Hamilton, Loudoun County, where they were placed at $50,000.

The writer did not visit any of the devastated communities, hence the facts recited were necessarily gathered from those who were near at hand. Direct observation of funnel cloud was made in three instances, Rye Cove, Woodville, and Cowpasture Valley. The lateness of the hour in the other cases probably accounts for lack of definite information as to that feature of the storm's appearance. Reports from observers from all the communities, class them as tornadoes. In the Cowpasture Valley, for at least a part of the storm path, trees were prostrated in one direction, that in which the storm was traveling. But this alone should not lead to the conclusion that it was not a tornado. The demolishing, lifting, and scattering of a building, greater destructiveness near the center of the path than on the borders, are features that indicate tornadic winds. Tornadoes travel rapidly, as a rule, passing any given point in a few moments of time. There is always a terrific noise, carrying consternation to any living thing in its path. Only by observing at a distance can a correct impression of a tornado's outer appearance be gained.

THE TROPICAL STORM OF JUNE 28, 1929

By W. P. DAY

Pressure had been low for several days previous to the 28th over the western portion of the Gulf of Mexico, but it was not until this date that any definite disturbance was more than suspected, a call for special observations being made on the morning of the 28th. A much delayed report from the steamship *Chester O. Swain* (the first vessel report in this region for several days) located the storm off the Texas coast and the following warning was immediately issued:

Hoist northeast storm warning 2 p. m. Galveston to Corpus Christi; disturbance of unknown but probably moderate intensity; central about latitude 27° N., longitude 95° 30′ W., apparently moving north-northwestward; will cause strong shifting winds probably gales at times on the Texas coast between Corpus Christi and Galveston.

The storm was of extremely small diameter, but of considerable intensity over a path about 20 miles in diameter from Port O'Connor to San Antonio. The lowest barometer reading probably was not below 29 inches, 29.12 being reported from Port O'Connor, 29.1 at Victoria, and 29.44 at San Antonio. Being of such small diameter, the storm did not last more than two or three hours at any one point, but estimated wind velocities as high as 80 miles per hour were reported. Corpus Christi and Galveston were only slightly affected.

Due to the difficulty in locating the storm, which was apparently in process of rapid development even as it struck the coast, adequate warnings were impossible for Port O'Connor and the southern portion of Matagorda Peninsula, the storm passing Port O'Connor at 4:30 p. m. The storm lasted from 4:30 to 6 p. m. at Port Lavaca and from 6:30 to 8 p. m. at Victoria.

HARRY CRAWFORD FRANKENFIELD, 1862–1929

The Weather Bureau has just sustained a serious loss in the death of Harry Crawford Frankenfield on July 29, 1929. While crossing Madison Place, Washington, D. C., about 8 p. m., July 22, he was knocked down and severely injured by an automobile operated by a hit-and-run driver. Doctor Frankenfield was taken immediately to Emergency Hospital where he lingered until the 29th when the end came.

He was buried in Arlington National Cemetery with military and masonic honors.

Doctor Frankenfield was born at Easton, Pa., on November 24, 1862; was graduated from Lafayette College in 1881 with the A. B. degree and he received the A. M. degree in 1884. He also held the degree of M. D. from Howard University, of Washington, D. C.

Upon graduation from college he enlisted in the United States Signal Corps and after passing through the several courses at the School of Instruction of the Signal Service at Fort Whipple (now Fort Myer, Va.), he was detailed for duty at the central office of that service in Washington, D. C. Here he came under the notice and attention of Gen. A. W. Greely, then Chief Signal Officer.

General Greely, among all of the bureau chiefs of the Federal Weather Service (and the writer of this note has served under each of them), had his own particular way of becoming acquainted with the work of his subordinates. It was the general's custom to make almost daily a quiet informal inspection of the several branches and divisions of his office and he naturally soon came to know not only the name of each employee, but also the nature of the work he was performing and he had, moreover, an almost uncanny way of telling whether the work was being done to the best advantage. Young Frankenfield soon gained the general's approval and it is not therefore surprising that in 1887, without previous experience in charge of Signal Service stations, he should be selected for charge of the Chicago station, one of the most important stations of the Federal Weather Service.

He succeeded to charge of the St. Louis station in 1894 and was next detailed to duty in the central office of the Weather Bureau in Washington, in 1898, as a national forecaster.

Frankenfield brought to this position a mind of the most nimble sort; he was unusually quick to visualize the general ensemble of the weather charts from day to day and with experience soon became a successful forecaster. His contributions to the art will be found in Weather Forecasting in the United States and other papers.

The work in which his interest was greatest, however, was not weather forecasting but the prediction of floods in the main rivers of the country. The amount of labor devoted to this subject was prodigious; as a result his knowledge of the idiosyncrasies of the relations between rainfall and run-off in the rivers of the United States is not surpassed by any one. Many of his contributions in this field having but a local interest have not been published but are preserved in manuscript at the several Weather Bureau stations. His papers on the historic floods in the great rivers of the country may be found in the series of Weather Bureau bulletins, letter file, and also among the supplements to the MONTHLY WEATHER REVIEW.

Doctor Frankenfield was also the author of Weather Bureau Bulletin, F Kite Observations of 1898 and many shorter papers. For recreation he enjoyed a game of bridge and played a fair game of billiards, notwithstanding a very unorthodox style of stroking the cue ball. He was fond of walking and professional baseball games, but he eschewed golf and other forms of physical exercise.

He was a member of the Philosophical Society of Washington, the Washington Academy of Sciences, the Cosmos Club, and a fellow of the American Meteorological Society. He belonged to the Masonic fraternity having served as master of his lodge.

Doctor Frankenfield is survived by his wife Katherine Thornton Frankenfield and a sister Miss Flora Frankenfield. He will be remembered by his many friends within and without the Weather Bureau for his genial ways, his open, frank criticisms, and the loyalty to the friends he made and held. To the field men of the service he was without doubt the best known of the Washington office officials; to them and his many friends wherever found his untimely passing away will be a grievous loss.—*A. J. H.*

NOTES, ABSTRACTS, AND REVIEWS

Dr. J. Patterson becomes director of the Canadian Meteorological Service.—The following letter will be of much interest to all readers of the REVIEW:

METEOROLOGICAL OFFICE,
Toronto, July 11, 1929.

DEAR PROFESSOR MARVIN: Sir Frederic Stupart retired from the position of director the 30th, June, and I have been appointed to succeed him. It shall ever be my desire to continue and develop the happy relationship that has always existed between the two services. I shall at all times be pleased to do anything in my power to advance our common interests.

Yours sincerely,

(Signed) J. PATTERSON.

Prof. C. F. MARVIN,
Washington, D. C.

The retiring director, Sir Frederic Stupart, entered the Canadian Meteorological Service in 1873, thus serving about 57 years. In 1894 he was made director. In 1916 he was knighted. Since Doctor Patterson has been associated with Sir Frederic for a great many years it is gratifying to know that the same cordial relations that have always existed between the meteorological services of the two countries will continue.—*Ed.*

R. De C. Ward's proposed guidebook to the world's weather and climates.—Prof. Robert De C. Ward, of Harvard University, in an address before the American Philosophical Society in April, 1928, suggested that the compilation of a guidebook to the weather and climates of the world would serve an extremely useful and educational purpose. "A complete guidebook," said Professor Ward, "should include three aspects of the general subject with which it deals. It should give descriptions of characteristic weather types, as, e. g., a typical day in the heart of the trade-wind belt at sea; a winter spell of bright, sunny weather in the Alps; a cold wave in the eastern United States; a summer rainy spell on the highlands of Scotland, and so on. It should next give simple but scientifically accurate descriptions of special local meteorological phenomena, such as the winter monsoon on the west coast of Japan; the 'cloud drip' on the island of Ascension; the typhoons of the eastern seas. Thirdly, it should give vivid descriptive accounts of the various climates to be met with in different parts of the world and their economic and general human relations, as, for example, the damp marine coast climate of Alaska,

with its dense vegetation, its glaciers, and its unsuitability for agriculture; the desert climate of the 'dead heart' of Australia, a great barren waste, without hope of any general reclamation or development; the modified tropical climate of the plateau of East Africa, with its possibilities for future white settlement; the continental climate of central Europe, neither as extreme as that of the northern interior of North America on the one hand nor as mild and even tempered as that of the British Isles on the other."—*A. J. H.*

Pilot-balloon observations at Apia, Samoa.—Mr. Andrew Thomson, director of Apia Observatory, has recently published the results of 380 pilot-balloon observations made at Apia, western Samoa (lat. 13° 48.4′ S.; long. 171° 46.5′ W.), during the period between May, 1923, and April, 1928.[1] An excellent feature of the pamphlet is the numerous graphs depicting various phases of the aerological data. Especially interesting among these are Figure 3, showing the variation of wind velocity with height and the number observations at different heights; Figure 5, showing the percentage frequency of wind direction at various levels; Figures 9 and 10, showing average altitude of boundary between winds with east-west and north-south components, respectively, and Figure 11, showing the constancy of wind direction at various levels.

In connection with the change of wind direction with height the author states:

> At the surface and up to a level of 0.25 kilometers the observed winds are from nearly true east all the year round. * * * At heights from 2 to 3 kilometers westerly winds become increasingly frequent, and at 8 kilometers, they are more common than easterly winds. Above this and up to at least 14 kilometers blows a strong steady wind from approximately southwest. From March to October this wind persists to an altitude of 20 kilometers.

Regarding the velocity and constancy of upper winds he states:

> The trade winds would appear to have their maximum velocity of 6.1 m.p.s. at about 0.25 kilometers altitude, decreasing continuously above this level. In the layer of westerly winds or counter trades the maximum velocity of 10.8 m.p.s. is reached at 11.5 kilometers. G. M. B. Dobson has shown that in England the tropopause is characterized by high and rapidly varying wind velocities. It is probable that the tropopause in the latitude of Apia is at least 14 kilometers high so that the maximum velocity here found for this station is not associated with the tropopause.

In view of the fact that the average wind velocities continue to increase with height aobve 14 kilometers and also that a month's series of sounding balloon observations made at Groesbeck, Tex. (lat. 31° 30′ N.; long. 96° 28′ W.), in October, 1927,[2] showed the mean height of the stratosphere to be 14.8 kilometers it is thought that its average height over Apia is appreciably greater, probably close to 17 kilometers.[3]

Regarding the steadiness of the winds the author states:

> For the whole year the winds from the surface to 3 kilometers are steady in direction. The greatest variability occurs at 4.5 kilometers but above 6 kilometers a fairly constant direction is again maintained. This is notably the case for the stratum lying between 10 and 12 kilometers. * * * The counter trades are almost as constant at the levels where they have the greatest velocity as are the trade winds blowing at the surface.

In discussing the mass movement of air which the author represents by the product of the mean velocity and the density of the stratum, he states,

> In the layers below 14 kilometers there is 5.3 times as much air transported toward the Equator during the year as moves polewards. Every month shows this excess of northward moving air. It can scarcely be counterbalanced by currents above 14 kilometers flowing away from the Equator, since the inclusion of all available data to 20 kilometers would increase the excess. The density of air at 20 kilometers altitude is only 3 per cent of that at the surface. Since the fraction of the atmosphere above 20 kilometers which is unaccounted for is so small it must be concluded that Apia is a point where there is a great inflow of polar air toward the Equator. * * * It is probable there is almost equality in the masses of air moving eastward and westward above Apia.

It is hoped that a larger objective may be substituted for the one which was used on the theodolite in view of the author's statement that higher observations would be possible if that were done. Based on experience with the theodolites used by the Weather Bureau it is thought that heights above 20 kilometers would be comparatively frequent under the conditions of light winds prevailing in that region. It also appears probable that "free-rising" captive balloon observations would be very successful at Apia.—*L. T. Samuels.*

Hailstorm at Duluth, Minn., June 10, 1929.—Thunder heard at 2 p. m. and from 3 p. m. to about 4:10 p. m. Rain from 3:40 p. m. to 4:10 p. m. From 2 p. m. to 6 p. m. the barometer fell at steady rate of about 0.10 inch in four hours, no surging effect indicated by barograph. Clouds prior to storm were the usual thunderhead type. Wind force varied from moderate to fresh before, during, and after the storm—from southwest to 3:45 p. m., west to 3:56 p. m., northwest to 4:06 p. m., then west. Maximum velocity was 23 miles from northwest in the five minutes beginning 4 p. m. Very sultry conditions had prevailed all day, as well as during and immediately following the storm; this was the only outstanding or noticeable weather feature.

Hail from 3:56 p. m. to 4:07 p. m. Ground fairly carpeted with hailstones varying from marble size to as large and larger than baseballs, the larger ones being mostly round and averaging the latter size. (The standard baseball is understood to weigh 5 ounces.) The big hailstones fell between 4:05 p. m. and 4:07 p. m. The largest found at the Weather Bureau immediately after the storm measured 3 by 3 by 4¾ inches and weighed 6 ounces. Some of the irregularly shaped hail were reported as being even larger. One measured by an official of the American Paint Co. at Superior Street and Thirtieth Avenue West was stated as being 3 by 4 by 5 inches and weighing 12 ounces, and there were unauthenticated reports of still larger ones. The water content of the larger hail probably averaged around 0.02 inch. There was also some difference in weight of hail averaging the same size. Many were beautifully marked with the concentric layers.

Forty minutes after the storm a hailstone was found at the Weather Bureau measuring 2½ by 3 by 4½ inches weighing 5 ounces; and two hours after falling several were found averaging ½ by 1 by 1¾ inches and weighing around 1 ounce. The Weather Bureau lawn and flower beds are spotted with innumerable holes where the large hail fell, the holes being as deep and in some instances deeper than the measured diameter of the hail. This condition was rather general in the area affected.

As near as can be ascertained the larger hail fell over an area extending from about Fortieth Avenue East to Thirty-fifth Avenue West and northwest to including Duluth Heights, a suburb, representing a section approximately 7 miles long by 2 miles wide.

Much damage resulted, especially to store windows facing northwest, street lights, auto windows and windshields, skylights, and greenhouses. The glass damage alone will probably run about $20,000. Pelting hail stones penetrated the tops of hundreds of automobiles,

[1] Observations of Upper Currents at Apia, western Samoa (2d series), by Andrew Thomson, director of Apia Observatory. 1929.
[2] Published in this REVIEW, pp.—
[3] Nature (London), June 1, 1929, pp. 834-835, by K. R. Ramanathan.

with perhaps no insurance coverage. A few people suffered minor injuries.—H. W. R.

Weather Bureau staff meetings, 1928–29, by W. R. Stevens, Secretary.—The regular biweekly meetings of the scientific and technical staff of the Central Office, which were initiated in the autumn of 1923, were continued during the winter of 1928–29. Following is a list of the discussions (asterisks denote speakers from outside the Weather Bureau).

October 3, 1928

W. R. Gregg. Meteorology as an aid to safe flying.

October 17, 1928

W. W. Reed. Discussion of two papers by W. Peppler.
(*a*) Contributions to the knowledge of the surface temperature of Lake of Constance.
(*b*) Changes in relative humididity over Lake of Constance with warm and cold invasions.

October 31, 1928

C. F. Marvin. Discussion of the transactions at the meteorological meetings in Paris and London.

November 14, 1928

A. J. Henry. Rainfall of China.
E. B. Calvert. Transactions at the meteorological meeting in London.

November 28, 1928

C. F. Marvin. Present status of calendar reform.
H. H. Kimball. A sunspot cycle of solar-constant values.

December 12, 1928

H. C. Willett. Some aspects of air-mass analysis.

January 9, 1929

O. L. Fassig. The hurricane of September, 1928.

January 23, 1929

H. C. Frankenfield. Discussion of the Mississippi River flood-control problem.
A. J. Henry. Monthly charts of pressure anomaly.

February 6, 1929

F. E. Matthes.* Some unusual forms of snow and ice.

February 20, 1929

F. G. Tingley. Load lines and other measures for safety at sea.

March 6, 1929

H. H. Kimball and W. J. Humphreys. Measurements of the amount of ozone in the earth's atmosphere and the altitude at which it is found.

March 20, 1929

W. J. Humphreys. Rainbows.

April 3, 1929

C. F. Marvin. Accumulated sums of departures as an index to climatic changes.

April 17, 1929

I. F. Hand. An investigation of the contamination of the atmosphere by an industrial plant.
A. J. Henry, H. C. Frankenfield, and R. H. Weightman. Discussion of the nomenclature of cyclones.

April 29, 1929

W. E. Hurd. (*a*) Northers of the Gulf of Tehuantepec.
(*b*) Tropical cyclones of southeastern North Pacific.
C. F. Brooks.* The 11-year period in San Diego rainfall.

May 13, 1929

C. F. Brooks.* Further studies of Gulf Stream temperatures and current in the Straits of Florida.

Meteorology. By David Brunt. 112 pages, 19 illustrations.—It is a rare pleasure to find an elementary work on any science that one can unreservedly recommend. This book by an important official in the meteorological office, London, affords that pleasure. It covers the entire range of meteorology, except the optical phenomena, about as fully, perhaps, as the average person cares to know it. There are no mathematical equations, and no attempt to discuss things that require for their elucidation this type of formal logic. Nevertheless, Dr. Brunt evidently assumes that his readers already have some knowledge and want more, for he writes as one scholar to another and not, as so many authors of popular science do, as a romancer to blockheads.

Each of the 11 chapters is excellent, but the one that treats of that most difficult subject, the Origin of Cyclonic Depressions, is so exceptionally good as to deserve especial mention.—*W. J. Humphreys.*

The past cold winter and the possibility of long-range weather forecasting,[1] *by W. J. Pettersson.*—Modern meteorology has made notable advances in forecasting the weather of the next day, but when it attempts to predict the weather for more than a week ahead, the percentage of successes does not exceed 50 at the most. One reason for this failure is to be found in the refusal of the modern meteorologist adequately to take into account in the problem of weather prediction of direct terrestrial influences, such as that of the physical state of the surface waters of the oceans, even though he may be ready enough to take such an influence into account when dealing with one of those aerodynamical problems—for example, the life history of an Atlantic "depression"—which he regards as lying within his particular province. Another reason is his neglect of the "Polar-front" theory of Professor Bjerknes, one of the greatest authorities on aerodynamics and hydrodynamics.

Professor Bjerknes regards the polar regions as caps of cold air maintained largely in consequence of the local accumulations of ice and snow, offering a kind of cold circular wall facing the warmer winds of temperate latitudes. He considers that in conjunction with the strongly heated equatorial regions, they set up a circulation which brings warm air aloft from the equator to the pole, there to be cooled and to sink, weighed down by its increasing density, until it is absorbed into the polar cap; that these reservoirs of cold air at the poles are constantly discharging their accumulated air toward the equator along the earth, in accordance with "impulses" supplied by the region of low barometer around the equator; that the trade winds represent successful at-

[1] Reprinted from NATURE, London, May 25, 1929.

tempts on the part of such accumulations of polar air to reach the region of equatorial calms. He supposes, further, that the cyclones of the north Atlantic arise through the mixing of the cold and warm air masses along the margin of the polar cap (the so-called "polar front").

It is clear that a great simplifying theory such as this offers a basis for long-range forecasting of the weather in our latitudes. If we accept the theory, it is not difficult to see that the general character of the weather over long periods may follow changes in the extent and shape of the region of cold sea, for the polar caps must, in the long run, coincide with the regions of coldest water. For example, the presence of a tongue of warm water projecting into Arctic regions, such as the so-called Gulf stream of the north Atlantic, will push this boundary back toward the pole, and cause contrasts such as are offered in winter by the cold climate of Labrador and the relatively mild climate of Iceland.

We may consider now whether the past severe winter can not be connected with some modification of the normal temperature of the seas within the area of exceptional cold. The immediate cause of the severe weather has clearly been the presistence of northerly and easterly winds over Russia and central Europe circulating round an "anticyclone" or region of high barometer over Scandinavia and Finland; which anticyclone has generally been separated from the area of high pressure that normally covers Siberia in winter by a region of relatively low pressure over Russia. Now Professor Witting found in the Baltic in the summer of 1927 a layer of cold water at a depth of about 10 fathoms, beneath the very warm surface water, heated by the sun, having altogether a volume much greater than that of a whole normal year's outflow from the Baltic into the North Sea, and having a temperature about 10° F. lower than the average. The surface waters of the Baltic are derived ultimately from the mixing of the river water with that finally ascending from such deeper layers, and this cold water might well chill their surface water, and the air in contact with them, for two years or more, in accordance with the time that the water might be expected to take in passing away along the Norwegian coast. Such chilling would cause the anticyclones which are so apt to form over Scandinavia to be more than usually persistent, as has been the case this winter. In this way the action of the cold water, which is far too small to produce directly a degree of cold such as has been observed, may do so indirectly through the agency of the wind, and the resulting accumulations of ice and snow will carry the process still further.

It seems clear that if the action of a single sea such as the Baltic can be so great, there is a great field open for international cooperation in the systematic study of the physical states not only of the Baltic but also of all the seas and oceans in and around Europe, including the Caspian and the Black Sea. This should be done once a year, if not twice, and the results should be published quickly, so as to be available for long-period weather forecasting. This was in fact the policy of the International Council for the Exploration of the Sea before the war. It is hoped that the remarks that I have made will show that permanently to abandon such a scheme may be to throw away the opportunities of saving millions of pounds that would be afforded by the prediction, in good time, of winters such as that of 1928–29.

June lake levels.—According to a report of the United States lake survey the lake levels for the current June are higher than a year ago by the following amounts:

Superior, 0.26 foot higher than in June 1928.
Huron, Mich., 2.08 feet higher than in June 1928.
Erie, 1.88 feet higher than in June 1928.
Ontario, 1.87 feet higher than in June 1928.

Meteorological summary for Chile, May, 1929 (by J. Bustos Navarrete, Observatorio del Salto, Santiago, Chile.)—The rainy season began in central Chile in this month, but precipitation was not frequent. The Pacific atmospheric circulation was particularly active in the first and third decades.

The important anticyclonic centers that were accompanied by fine, cold weather were charted as follows: 5th to 6th, moving from central Chile toward Argentina; 9th to 12th and 14th to 19th, passing from Chiloe to the northern part of Argentina, and 25th to 30th, forming over the Juan Fernandez Islands, recurving toward the south near Chiloe, and later passing over Cordoba.

There were three important depressions attended by unsettled weather, wind, and rain during the periods 3d to 5th, 6th to 8th, and 23d to 25th. The first of these brought the first rain of the season in the central region on the 4th, the second crossed the extreme southern (austral) region, and the third caused general rains in the southern and central regions and snows on the cordilleras.

Monthly totals of precipitation were as follows: Region of Santiago about 2.40 inches, region of Concepcion about 6.70 inches, and region of Valdivia between 6.70 and 9.40 inches.—*Translated by W. W. R.*

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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS, JUNE, 1929

By HERBERT H. KIMBALL

For reference to descriptions of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to this volume of the REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged slightly below normal values for June at all three stations at which measurements are made.

Table 2 shows an excess in the total radiation received on a horizontal surface at Washington, as compared with the June normal for that station, is close to normal at Madison and Lincoln, and is deficient at Chicago and New York.

Skylight polarization measurements obtained on three days at Washington give a mean of 46 per cent with a maximum of 50 per cent on the 13th. These are close to the corresponding averages for June at Washington. At Madison measurements obtained on six days give a mean of 56 per cent, with a maximum of 61 per cent on the 19th and 29th. These are slightly below the corresponding averages for June at Madison.

TABLE 1.—*Solar radiation intensities during June, 1929*

[Gram-calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass, A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
Washington, D. C.											
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
June 4	6.27	0.60	0.72	0.87	1.06	1.31					5.36
June 11	9.14			0.59	0.86	1.12	0.63				8.81
June 12	11.38			0.38	0.60	1.12					12.68
June 13	15.11		0.70	0.87	1.03	1.26					13.13
June 14	14.60					1.17					17.37
June 17	16.20					1.15					14.10
June 18	16.20			0.76	0.94	1.15					14.60
June 19	15.65				0.76						17.37
Means		(0.60)	(0.71)	0.69	0.88	1.18	(0.63)				
Departures		+0.03	+0.05	−0.06	−0.03	−0.04	−0.28				
Madison, Wis.											
June 5	7.29					1.36					7.57
June 8	4.75				0.89						7.87
June 15	10.97				1.01	1.27					12.24
June 19	14.60				1.13	1.39					11.38
June 20	12.68					1.41					8.81
June 21	8.81			0.87							7.29
June 25	9.14		0.75	0.92	1.06	1.31					7.57
June 26	10.21			0.98	1.12	1.38					9.83
June 28	9.83			0.81							10.59
June 29	12.24			0.94	1.07						11.38
Means			(0.75)	0.90	1.05	1.35					
Departures			−0.12	−0.06	−0.05	+0.02					
Lincoln, Nebr.											
June 9	13.61		0.49	0.63	0.78	1.07					13.59
June 11	17.37		0.62	0.76	0.98	1.21					19.23
June 13	8.48		0.67	0.85	1.07	1.35	1.14	0.88	0.72		7.57
June 14	9.47		0.72	0.89	1.11	1.39					9.47
June 15	12.68		0.62	0.77	0.93	1.11					10.59
June 19	11.38		0.77	0.94	1.14	1.39	1.01				8.18
June 20	8.18						1.19	1.05	0.88		6.27
June 21	8.81			0.90	1.12	1.40					8.48
June 25	10.21		0.69	0.85	1.07	1.38					8.18
June 28	9.47		0.94	1.03	1.24	1.42	1.07	0.91	0.73		9.47
Means			0.69	0.85	1.05	1.30	1.10	0.95	0.78		
Departures			−0.08	−0.08	−0.05	−0.05	±0.00	+0.04	−0.01		

[1] Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation: Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Fresno	Average daily departure from normal: Washington	Madison	Lincoln	Chicago	New York
1929	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
June 4	542	584	423	491	404	556	627	+56	+67	−105	+70	−8
June 11	634	384	576	276	398	695	673	+132	−115	+40	−136	−10
June 18	518	539	616	410	382	887	762	+46	+19	+56	−4	−17
June 25	460	542	607	346	313	802	726	−52	+2	+19	−96	−88
Excess or deficiency since first on year on July 1								+609	−1,246	−628	−133	−3,388

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. C. S. Freeman, Superintendent U. S. Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

Date	Eastern standard civil time		Heliographic: Diff. long.	Longitude	Latitude	Area: Spot	Group	Total area for each day
1929	H.	m.	°	°	°			
June 1 (Naval Observatory).	10	52	−62.0	16.6	+13.5		46	
			+21.0	99.6	+17.5		22	
			+58.5	137.1	+14.5	417		485
June 2 (Naval Observatory).	12	28	−46.0	18.5	+13.5	15		
			−39.5	25.0	−19.0		77	
			+72.0	136.5	+14.5	432		524
June 3 (Naval Observatory).	11	44	−84.5	327.1	−9.5	123		
			−35.5	16.1	−15.5	6		
			−33.0	18.6	+13.5	22		
			−25.0	26.6	−16.0	12		
			+17.5	69.1	+11.0	9		
			+23.5	75.1	−16.5	6		
			+85.0	136.6	+14.0	463		641
June 4 (Naval Observatory).	11	36	−78.0	320.5	+5.5		216	
			−69.0	329.5	−8.5		139	
			−20.0	18.5	+13.5	15		
			+32.0	70.5	+10.5		25	
			+38.0	76.5	−17.0	9		404
June 5 (Naval Observatory).	11	10	−68.5	317.0	+6.5		262	
			−55.5	330.0	−9.0		185	
			−6.5	19.0	+13.0	9		
			+50.0	75.5	−17.5		123	579
June 6 (Naval Observatory).	11	21	−78.0	294.1	−18.5	123		
			−55.0	317.1	+6.0		201	
			−42.5	329.6	−9.0		216	
			+18.0	30.1	−10.0	9		
			+65.0	77.1	−17.5		231	780
June 7 (Naval Observatory).	11	25	−68.5	290.4	+24.5	15		
			−64.5	294.4	−18.5	93		
			−40.5	318.4	+6.0		139	
			−28.5	330.4	−9.0		262	
			+32.5	31.4	−11.0	3		
			+77.0	75.9	−17.5		340	852
June 8 (Harvard)	12	42	−50.5	293.0	−18.5		148	
			−24.5	319.0	+7.0	166		
			−13.0	330.5	−8.5	466		780
June 9 (Naval Observatory).	14	33	−36.5	294.2	−19.0	93		
			−12.5	318.2	+5.5		108	
			0.0	330.7	−9.5		355	556
June 10 (Naval Observatory).	11	21	−30.0	289.2	−7.0		15	
			−25.5	293.7	−18.5	108		
			+0.5	319.7	+6.5		123	
			+13.0	332.2	−8.5		293	539
June 11 (Naval Observatory).	11	21	−78.0	228.0	−11.0	77		
			−75.0	231.0	+13.0	108		
			−45.5	260.5	−4.0		56	
			−11.5	294.5	−19.0	93		
			+2.5	308.5	+9.5		31	
			+14.0	320.0	+6.5		80	
			+25.5	331.5	−8.5		309	754
June 12 (Naval Observatory).	11	26	−64.5	228.2	−11.5		93	
			−62.0	230.7	+13.5	108		
			−32.0	260.7	−4.5		93	
			−5.0	287.7	−7.0		77	
			+1.0	293.7	−19.0	86		
			+27.0	319.7	+7.0		77	
			+39.5	332.2	−8.0		324	858
June 13 (Naval Observatory).	11	30	−82.0	197.4	−17.0	201		
			−51.5	227.9	−11.0	62		
			−48.0	231.4	+13.5	77		
			+10.0	289.4	−6.0	31		
			+14.5	293.9	−19.5	77		
			+38.0	317.4	+9.5		46	
			+39.0	318.4	+7.0	62		
			+54.0	333.4	−8.5		293	849
June 14 (Naval Observatory).	11	23	−68.5	197.7	−16.5	139		
			−38.5	227.7	−11.0	62		
			−35.0	231.2	+13.5	62		
			+23.0	289.2	+7.5		62	
			+28.0	294.2	−19.5	46		
			+52.5	318.7	+7.0	62		
			+52.5	318.7	+9.5		37	
			+65.0	331.2	−8.5		247	717

Positions and areas of sun spots—Continued

Date	Eastern standard civil time		Heliographic			Area		Total area for each day
			Diff. long.	Longitude	Latitude	Spot	Group	
1929	*H.*	*m.*	°	°	°			
June 15 (Naval Observatory).	10	39	−56.5	196.9	−16.5		93	
			−24.5	228.9	−11.5		93	
			−22.0	231.4	+13.5	46		
			+19.0	272.4	+9.0		46	
			+36.5	289.9	−8.5		37	
			+40.5	293.9	−19.0	15		
			+66.0	319.4	+7.0	77		
			+70.0	323.4	+10.0	12		
			+76.0	329.4	−9.5	62		
			+76.0	329.4	−7.0	15		496
June 16 (Naval Observatory).	11	15	−43.0	196.8	−16.0		77	
			−12.5	227.3	−11.5		77	
			−8.0	231.8	+13.5	46		
			−2.0	237.8	+9.5		24	
			+33.0	272.8	+8.5		77	
			+50.5	290.3	−8.5		57	
			+79.5	319.3	+7.0	77		
			+84.0	323.8	+10.5	31		466
June 17 (Naval Observatory).	11	18	−30.0	196.6	−16.0		68	
			+1.0	227.6	−12.0		46	
			+2.5	229.1	+14.0		52	
			+13.0	239.6	+9.0		56	
			+47.5	274.1	+8.0		77	299
June 18 (Naval Observatory).	11	10	−82.0	131.4	−5.5		123	
			−78.5	134.9	+12.5	262		
			−77.0	136.4	−8.5		478	
			−17.0	196.4	−16.5		68	
			+14.0	227.4	−12.0		15	
			+16.0	229.4	+13.5		46	
			+27.5	240.9	+8.5		62	
			+62.5	275.9	+8.0		65	
			+77.5	290.9	−7.0		46	1,165
June 17 (Naval Observatory).	11	17	−69.5	130.6	−5.0		77	
			−64.5	135.6	+12.5	309		
			−62.0	138.1	−9.0		525	
			−3.5	196.6	−15.0		37	
			+27.5	227.6	−12.0	3		
			+31.5	231.6	+13.5	31		
			+41.0	241.1	+9.0		108	
			+42.0	242.1	−7.5	6		
			+74.5	274.6	+7.5		108	1,204
June 20 (Naval Observatory).	11	20	−64.0	122.8	−9.0		62	
			−55.5	131.3	−5.0		77	
			−50.5	136.3	+12.5	370		
			−47.5	139.3	−9.0		448	
			+10.5	197.3	−15.0	12		
			+44.5	231.3	+13.5	15		
			+54.0	240.8	+9.0		170	
			+55.5	242.3	−8.5		77	
			+88.0	274.8	+7.5	62		1,293
June 21 (Naval Observatory).	11	13	−52.0	121.7	−9.5		93	
			−41.0	132.7	−5.0		37	
			−38.0	135.7	+13.0	324		
			−34.0	139.7	−9.0		509	
			−13.0	160.7	+15.0		31	
			+12.0	185.7	−19.5		77	
			+23.5	197.2	−15.0	15		
			+48.0	221.7	+16.0		31	
			+57.5	231.2	+13.5	6		
			+66.5	240.2	+9.0		170	
			+68.5	242.2	−8.5		123	1,416
June 22 (Naval Observatory).	11	2	−79.5	81.0	−17.5	185		
			−38.0	122.5	−9.0		123	
			−29.0	131.5	−5.0		62	
			−25.0	135.5	+13.0	324		
			−21.0	139.5	−9.5		540	
			+1.0	161.5	+14.5		37	
			+26.0	186.5	−17.5		139	
			+37.0	197.5	−15.5	9		
			+61.5	222.0	+15.5		31	
			+81.0	241.5	−9.0	154		1,604
June 23 (Naval Observatory).	11	1	−65.5	81.8	−17.5	154		
			−25.5	121.8	−9.0		185	
			−12.0	135.3	+13.0	309		
			−7.5	139.8	−9.5		571	
			+14.5	161.8	+14.0		37	
			+40.5	187.8	−16.5		154	
			+50.5	197.8	−15.5	12		1,422
June 24 (Naval Observatory).	11	54	−51.5	82.1	−17.5	154		
			−10.5	123.1	−8.5		154	
			+2.0	135.6	+13.0	278		
			+7.5	141.1	−10.0		525	
			+31.5	165.1	+13.0		9	
			+55.0	188.6	−16.5		154	1,274

Positions and areas of sun spots—Continued

Date	Eastern standard civil time		Heliographic			Area		Total area for each day
			Diff. long.	Longitude	Latitude	Spot	Group	
1929	*H.*	*m.*	°	°	°			
June 25 (Naval Observatory).	11	18	−72.0	48.7	−13.0	12		
			−38.5	82.2	−17.5	154		
			−30.0	90.7	−17.0	6		
			+2.0	122.7	−8.0		77	
			+15.0	135.7	+13.0	309		
			+21.0	141.7	−10.0		478	
			+45.0	165.7	+13.5	6		
			+67.5	188.2	−16.5		216	1,258
June 26 (Naval Observatory).	14	48	−77.0	28.5	−18.0		139	
			−67.0	38.5	+6.5	6		
			−57.5	48.0	−13.0	9		
			−24.0	81.5	−17.5	154		
			−15.0	90.5	−17.0	3		
			+17.0	122.5	−8.0		46	
			+30.0	135.5	+12.5	324		
			+36.5	142.0	−10.0		448	
			+80.0	185.5	−16.5	31		1,160
June 27 (Naval Observatory).	11	19	−64.5	29.7	−17.5		123	
			−56.0	38.2	+7.0	6		
			−45.5	48.7	−11.0		9	
			−12.5	81.7	−17.0	154		
			−9.5	84.7	+11.5		6	
			+30.0	124.2	−7.0		15	
			+41.5	135.7	+13.5	324		
			+48.0	142.2	−9.0		463	1,100
June 28 (Mount Wilson).	13	30	−75.0	4.8	−10.0	4		
			−75.0	4.8	+5.0	9		
			−51.0	28.8	−18.0		11	
			−45.0	34.8	+8.0		41	
			+2.0	81.8	−18.0	200		
			+56.0	135.8	+13.0	442		
			+60.0	139.8	+8.0		10	
			+65.0	144.8	−9.0		463	1,180
June 29 (Naval Observatory).	10	31	−88.0	340.2	−10.0		170	
			−70.5	357.7	−14.0	6		
			−64.5	3.7	−9.5		37	
			−64.5	3.7	+6.5		46	
			−36.5	31.7	−19.0		15	
			−33.0	35.2	+7.5		93	
			+13.0	81.2	−16.5	154		
			+67.5	135.7	+13.0	309		
			+77.5	145.7	−9.5	262		1,092
June 30 (Naval Observatory).	11	16	−74.0	340.5	−9.0		432	
			−57.0	357.5	−13.0	6		
			−49.5	5.0	−8.5		18	
			−49.5	5.0	+6.5		154	
			−19.5	35.0	+8.0		53	
			−15.5	39.0	−12.0		15	
			+26.0	80.5	−16.5	154		
			+75.5	130.0	−5.0	12		
			+81.0	135.5	+12.5	247		1,091
Mean daily area for June.								895

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR JUNE, 1929

[Data furnished through the courtesy of Prof. W. Brunner, University of Zurich, Switzerland]

June, 1929	Relative numbers	June, 1929	Relative numbers	June, 1929	Relative numbers
1	27	11	82	21	M [1] 101
2	30	12	[4] 88	22	[2] 110
3	26	13	84	23	104
4	W [1] [2] 47	14	79	24	[3] 84
5	54	15	M [1] 80	25	[4] 80
6		16	M [1] 76	26	85
7		17	[4] 64	27	62
8	68	18	[3] 76	28	E [4] [1] 65
9	[2] 58	19	[4] 70	29	E [1] 79
10	[4] 68	20	91	30	[3] 84

Mean (28 days) = 72.2.

[1] New formation of a large or average-sized center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central zone.
[2] Entrance of a large or average-sized center of activity on the east limb.
[3] Passage of a large group through the central meridian.
[4] Passage of an average-sized group through the central meridian.

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Free-air temperature departures for the month were negative generally and of moderate magnitude at all levels observed at Due West, Ellendale, and Royal Center. (Table 1.) The mean temperatures were practically normal at Broken Arrow and Groesbeck and above normal at Washington.

Relative humidity departures were mostly negative except at Due West where large positive values occurred, especially at the 2,500 and 3,000 meter levels.

Vapor pressures were mostly below normal with positive departures in the upper levels at Due West, Royal Center, and Washington. It is significant to note that at Ellendale, where negative temperature departures occurred together with negative relative humidity departures and exceptionally large negative vapor pressure departures up to the 1,000 meter level the total monthly precipitation was only 0.47 inch as compared to a normal of 4.59 inches. Also at Due West where an excess in the relative humidity and vapor pressures occurred with negative temperature departures, the total precipitation was 5.2 inches the highest amount for June, excepting one, since the establishment of the station in 1921.

TABLE 3.—*Observations by means of kites, captive and limited height sounding balloons, and airplanes during June, 1929*

	Broken Arrow, Okla.	Due West, S. C.	Ellendale, N. Dak.	Groesbeck, Tex.	Royal Center, Ind.	Naval Air Station, D. C.
Mean altitudes, (meters) M. S. L., reached during month	2,601	2,010	2,532	2,309	2,763	3,344
Maximum altitude (meters), M. S. L., reached and date	[1] 4,363	[2] 4,159	[3] 4,448	[1] 4,715	[4] 4,965	[5] 6,190
Number of flights made	25	17	31	26	27	16
Number of days on which flights were made	25	17	29	26	25	16

[1] 25th. [2] 29th. [3] 18th. [4] 3d. [5] 10th.

In addition to the above there are approximately 100 pilot balloon observations made daily at 45 Weather Bureau stations in the United States.

The resultant winds for the month below the 1,000-meter level were variable. (Table 2.) At the 3,000-meter level the resultant direction was westerly at practically all stations except the extreme South, where it was easterly and the resultant velocities ranged from 8 m. p. s. in the North to 1 m. p. s. in the South. At 5,000 meters the resultant air movement was mostly from the northwest. From the 20th to 24th, inclusive, the 7 a. m. balloon observation at Oakland, Calif., extended to 11 kilometers. From 5 kilometers to this level the resultant direction was slightly west of south and the velocity about 15 m. p. s.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during June, 1929*

TEMPERATURE (° C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters) Mean	Departure from normal	Due West, S. C. (217 meters) Mean	Departure from normal	Ellendale, N. Dak. (444 meters) Mean	Departure from normal	Groesbeck, Tex. (141 meters) Mean	Departure from normal	Royal Center, Ind. (225 meters) Mean	Departure from normal	Washington, D. C. (Naval air station) (7 meters) Mean	Departure from normal
Meters												
Surface	23.9	−1.0	23.4	−2.3	18.2	−0.5	23.3	−2.6	21.4	−0.4	23.2	−0.1
500	21.8	−1.1	20.9	−1.8	17.7	−0.6	22.3	−0.6	18.6	−0.3	19.8	0.0
1,000	20.1	0.0	17.8	−1.6	14.4	−0.9	20.7	+0.4	15.1	−0.5	17.9	+0.9
1,500	17.6	+0.1	14.3	−1.8	11.6	−1.1	18.7	+0.6	12.1	−0.7	15.3	+1.3
2,000	14.8	0.0	11.3	−1.5	8.7	−1.1	15.7	−0.1	9.1	−1.1	12.4	+1.3
2,500	12.2	+0.2	8.0	−1.6	5.8	−1.1	13.0	−0.2	6.4	−1.1	9.4	+1.1
3,000	8.7	−0.3	5.3	−1.2	2.0	−2.1	10.3	−0.2	3.6	−1.2	6.4	+1.0
4,000	4.3	+1.5	−0.1	−0.6	−3.4	−1.8	4.5	−0.5	−1.2	−1.0	2.7	+3.7
5,000											−3.5	+3.7

RELATIVE HUMIDITY (%)

Altitude m. s. l.	Broken Arrow Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure	Washington Mean	Departure
Surface	75	+3	74	+9	58	−12	86	+11	64	−2	62	−3
500	75	+3	74	+6	58	−11	81	+3	67	−1	62	−3
1,000	63	−8	75	+6	59	−8	63	−9	68	−1	54	−9
1,500	57	−10	82	+11	56	−8	53	−9	65	−2	56	−7
2,000	49	−12	83	+12	52	−10	52	−2	64	+2	57	−8
2,500	40	−14	96	+24	49	−12	46	−3	59	+3	55	−6
3,000	41	−9	96	+27	49	−8	40	−6	49	−3	49	−9
4,000	3	−46	20	−36	53	+3	20	−24	33	−8	37	−13
5,000											28	−13

VAPOR PRESSURE (*mb.*)

Altitude m. s. l.	Broken Arrow Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure	Washington Mean	Departure
Surface	22.42	−0.20	20.89	−0.03	12.14	−3.15	24.76	+0.15	16.74	−0.58	18.69	−0.49
500	19.74	−0.35	18.18	−0.23	11.78	−3.04	21.77	+0.06	54.82	−0.06	15.11	−0.30
1,000	14.68	−1.86	15.28	−0.19	9.70	−2.03	15.33	−1.71	12.10	−0.39	11.73	−0.63
1,500	11.22	−1.90	13.45	+0.49	7.83	−1.60	11.17	−1.60	9.70	−0.57	10.26	+0.06
2,000	8.26	−1.75	11.06	+0.57	6.02	−1.58	9.32	−0.30	8.08	+0.18	8.65	+0.10
2,500	5.48	−1.89	10.57	+2.00	4.71	−1.55	7.25	−0.25	6.37	+0.61	6.85	+0.37
3,000	4.14	−1.44	8.73	+1.99	3.77	−1.06	5.73	−0.20	4.80	+0.51	5.02	+0.06
4,000	0.34	−3.33	0.60	−2.85	3.12	+0.01	3.19	−0.80	3.11	+0.93	3.13	+0.30
5,000											1.72	+0.30

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during June, 1929*

Altitude m. s. l.	Broken Arrow, Okla. (233 meters) Direction	Velocity	Burlington, Vt. (132 meters) Direction	Velocity	Cheyenne, Wyo. (1,868 meters) Direction	Velocity	Due West, S. C. (217 meters) Direction	Velocity	Ellendale, N. Dak. (444 meters) Direction	Velocity	Groesbeck, Tex. (141 meters) Direction	Velocity	Havre, Mont. (762 meters) Direction	Velocity	Jacksonville, Fla. (65 meters) Direction	Velocity	Key West, Fla. (11 meters) Direction	Velocity	Los Angeles, Calif. (40 meters) Direction	Velocity
Meters	°		°		°		°		°		°		°		°		°		°	
Surface	S 39 E	1.6	S 14 W	2.2	N 78 W	3.1	S 74 W	0.8	N 23 W	0.6	S 24 E	1.0	S 56 W	1.8	S 45 W	0.8	S 21 E	1.9	N 65 E	1.5
500	S 14 W	5.5	S 42 W	3.9			S 82 W	2.7	N 45 W	0.8	S 19 W	7.0			S 24 W	2.2	S 37 E	4.0	S 84 E	1.1
1,000	S 33 W	7.5	N 88 W	4.7			S 88 W	3.6	S 76 W	1.1	S 16 W	6.3	S 72 W	3.9	S 39 W	1.9	S 33 E	3.9	N 21 W	1.0
1,500	S 60 W	5.6	S 84 W	5.9			N 85 W	3.6	N 66 W	2.6	S 12 W	4.2	N 81 W	4.5	S 66 W	1.7	S 35 E	3.7	N 46 W	2.3
2,000	S 74 W	4.8	S 79 W	7.0	S 87 W	6.7	S 89 W	4.1	N 70 W	3.4	S 27 W	2.6	N 87 W	5.6	S 69 W	1.9	S 30 E	2.6	N 68 W	2.7
2,500	N 88 W	4.8	S 87 W	6.9	N 88 W	7.7	S 85 W	4.4	N 83 W	6.2	S 35 W	1.7	N 81 W	5.8	S 52 W	1.6	S 45 E	1.5	N 80 W	3.9
3,000	N 49 W	5.0	S 88 W	7.5	N 82 W	7.2	W	4.0	N 79 W	7.0	N 51 E	0.3	N 80 W	6.3	S 62 W	2.5	S 30 E	1.4	N 84 W	4.4
4,000	N 51 W	5.1	N 87 W	9.3	N 83 W	9.0	N 48 W	3.9	N 83 W	9.4	N 42 E	3.0	N 84 W	8.5	S 59 W	2.1	S 64 W	1.5	N 88 W	5.5
5,000	N 52 W	6.5			N 80 W	11.7	N 73 W	3.3	N 78 W	10.4	N 19 E	3.4	S 89 W	10.6	S 72 W	2.9			S 66 W	6.1

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during June, 1929*—Continued

Altitude m. s. l.	Medford, Oreg. (446 meters)		Memphis, Tenn. (145 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. (313 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,280 meters)		San Francisco, Calif. (60 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (67 meters)		Washington, D. C. (34 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Meters	°		°		°		°		°		°		°		°		°		°	
Surface	N 24 W	0.5	S 76 E	1.8	N 33 E	0.5	S 28 E	0.9	S 20 E	0.8	S 12 E	2.4	S 6 E	0.4	N 81 E	0.6	S 43 E	0.8	N 76 W	0.3
500	N 29 W	0.7	S 44 W	3.6	S 58 E	1.2	S 5 W	2.5	S 45 W	2.5	----------	----	N 17 W	2.6	S 63 W	1.6	S 28 E	0.6	N 27 W	2.6
1,000	S 76 W	0.6	S 74 W	4.3	S 20 E	1.8	S 56 W	5.2	W	4.0	----------	----	N 3 W	3.9	N 83 W	3.5	S 7 W	1.2	N 28 W	3.2
1,500	S 13 W	1.7	S 80 W	4.5	S 18 E	1.6	S 79 W	5.1	N 89 W	5.0	S 12 E	3.4	N 20 W	2.9	N 75 W	4.5	S 35 W	1.8	N 41 W	3.6
2,000	S 59 W	2.3	N 79 W	4.1	S 28 E	1.6	S 86 W	5.5	N 80 W	5.6	S 7 W	4.2	N 36 W	2.7	N 78 W	5.7	S 17 W	1.8	N 53 W	5.2
2,500	S 72 W	4.5	N 71 W	3.3	N 88 E	0.8	N 81 W	6.3	S 89 W	5.1	S 32 W	3.8	N 59 W	3.1	N 74 W	7.6	S 35 W	3.0	N 62 W	6.2
3,000	S 79 W	5.9	N 58 W	2.8	N 68 E	1.3	N 72 W	7.5	N 82 W	6.2	S 51 W	4.5	N 72 W	4.6	N 67 W	8.3	S 59 W	4.7	N 65 W	6.7
4,000	S 80 W	9.6	N 38 W	3.8	N 27 E	2.5	N 52 W	12.6	N 72 W	10.5	S 54 W	6.2	N 67 W	6.5	N 60 W	10.0	S 70 W	5.3	N 47 W	7.9
5,000	S 50 W	12.6	N 28 W	4.0	N 14 E	3.0	----------	----	N 79 W	11.8	S 82 W	8.8	S 86 W	7.7	----------	----	----------	----	N 66 W	7.2

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL SUMMARY

June, 1929, was unmarked by important variations from normal summer weather, and, on the whole, was not physically uncomfortable, save in a few localities. It was generally favorable for the occupations of the season and conducive in the main to the favorable development of crops and the orderly progress of business.

PRESSURE AND WINDS

The pressure changes during the month were unusually slight from day to day and cyclonic storms that preserved their identity sufficiently from day to day to permit of charting on successive days were the exception.

The month opened with rainy conditions existing during the preceding 24 hours over a considerable area in the southern Rocky Mountains and Great Plains region, some heavy rains having fallen in the lower Missouri Valley, and local heavy rains had occurred also at a few scattered points in Virginia, Florida, and Alabama. The following day local showers continued in the Missouri Valley, extending into the upper Mississippi Valley, with heavy falls at points in Iowa and southern Illinois. By the morning of the 3d the main precipitation area had advanced to the south Atlantic coast with fairly well-defined cyclonic formation, attended by rather general and locally heavy precipitation over the Southeastern States, and showers still continued in portions of the central valleys. The rainy conditions in the Southeast passed off the coast by the morning of the 4th and fair weather prevailed over most districts for several days.

At the morning observation of the 7th rain had set in over the middle Plains, becoming locally heavy in a few instances, and by the following morning rain had extended into many eastern sections, becoming heavy locally in widely separated portions of the Mississippi and Ohio Valleys and Gulf States, the rains continuing on the 9th in portions of the Atlantic Coast States where, during the following 24 hours, there was some evidence of an increase in the cyclonic development as it passed northeastward up the coast, though without any extensive precipitation.

By the morning of the 11th rainy conditions had overspread portions of the northern districts from the Rocky Mountains to the upper Lakes, though without important precipitation except in portions of the last-named region. During the following day the pressure continued low to the eastward and local thundershowers prevailed over extensive areas in the upper Mississippi Valley, Lake region, and northern drainage of the Ohio River, thundershowers with high winds and destructive hail storms being reported from numerous points in Iowa and portions of near-by States. This area of atmospheric disturbance continued during the following day, becoming rather general over the Ohio Valley with some heavy rains at points in Tennessee and near the lower Ohio River, showers continuing during the 14th over a rather extensive area from the upper Lakes southward to the middle Gulf coast, and to some extent over the Atlantic coast districts on the following day or two.

The latter half of the second decade was without important precipitation, save that on the 19th showers were reported from scattered points in the Southeastern States, locally in the Mississippi Valley and upper Lakes region, and in the far Northwest, and showers continued during the following day in the same or near-by areas.

During the first half of the last decade precipitation was scattered and mostly light to eastward of the Rocky Mountains and practically none occurred to the westward. On the 25th showers were fairly general in the southern Plains and to eastward of the Mississippi River, heavy rains occurring in portions of the Gulf States, particularly in western Florida and southern Alabama and in Arkansas and near-by portions of Texas. Showers continued during the following day over the more eastern part of the rain area and in the district from the upper Lakes westward to the Rocky Mountains, though here the precipitation was mostly in the form of light showers.

On the 27th showers prevailed in many portions of the Southeastern States and also in the near Northwest, the rains becoming light, however, in this area. During the following day the precipitation area extended eastward into the Great Lakes region and northern Ohio drainage with local heavy rains at points in Wisconsin and Michigan, and another rain area developed over the Gulf coast district, the combination of the two rain areas covering the more eastern portions of the entire country by the following morning.

At the close of the month the main agricultural areas of the country were not greatly in need of rain where it may usually be expected at that season of the year. While no great barometric depressions favored the occurrence of high winds over extensive areas, yet local storms were numerous and occurred at some point east of the Rocky Mountains on practically every day of the month,

though few assumed the violence and destruction of tornadoes and the loss of life from this source was comparatively light, though property damage was rather widespread, both from wind and hail. A list of the more important local storms with some of their details appears at the end of this section.

The average sea-level pressure for June was mainly above normal in the interior and northern sections and below normal over most eastern districts and locally in the South and far Northwest. In Canada the average pressure appears to have been less than normal.

The barometric change from the preceding month was everywhere negative and this applies to Canada as far as observations disclose. These changes were comparatively large in nearly all districts, ranging from 0.10 to 0.25 inch in the central valleys and near-by Canadian sections.

TEMPERATURE

Moderate temperatures were the rule throughout the month; on only a few dates were the 24-hour changes in excess of 20° and these were confined to the more northern districts.

The most important changes were on the 1st, from the upper Lakes eastward, when changes to cooler ranged up to 28° at points in Wisconsin, Michigan, and northern New York, and on the following day changes up to 20° or more were noted at points in the interior of the country from the Middle Plateau eastward to near the Atlantic coast. Rather important changes to cooler were noted on the 12th, when high pressure dominated the upper Lake region, and temperature falls of more than 30° were reported from points in the northern portions of Wisconsin and Michigan. At no time, however, were the important agricultural districts threatened with temperatures sufficiently low to endanger staple vegetation, except at the beginning when freezing temperatures were noted at points in the Appalachian Mountains and also in the higher western mountains.

The average temperatures for the period covering the 4th to 11th were cooler than normal over the eastern half of the country and along the Pacific coast, and generally warm over the Rocky Mountain and near-by areas, though the excesses were not large. In the central eastern area the negative values ranged up to 9° and similar values were noted in the Great Valley of California. The period, 11th to 18th, was mainly cool in the far West, particularly in the Plateau region. It was warm in the Northeast and somewhat warmer than normal over most Rocky Mountain districts, and only slightly variant from the normal in the Great Plains, central valleys, and Southeast. The week ended June 25 had some cool weather during the early part in the far West and Northwest, and the week, as a whole, was cooler than normal from the central parts of Oregon and Washington eastward to the upper Mississippi Valley, the area covered by the upper Missouri Valley and North Dakota averaging from 6° to 9° cooler than normal. Over other parts the averages were everywhere higher than normal and decidedly so at points in the central and coast districts of California and in the Northeastern States, where the positive departures ranged up to as much as 9° to 12° per day. The last five days of the month continued unusually warm over most of the western half of the country, the period being particularly warm over the Plateau States and eastern California. From the Rocky Mountains eastward the period was cooler than normal, but the negative departures were not large.

For the month, as a whole, the average temperatures were below normal by small amounts over most of the country, a small area in the Southwest, however, having averages uniformly above the normal and scattered areas in many far-western sections had localities with temperatures above the normal for the month, and a small area in the Northeastern States had temperatures likewise warmer than normal. In no extensive areas, however, were the temperatures more than 2° or 3° above or below the respective normals.

The highest temperatures were recorded mainly during the last decade, though in a few States they were recorded earlier. The maximum record for the month, 125°, occurred at a point in Arizona, but a temperature of 124° was recorded in the desert regions of California and maximum temperatures of 100° or above were recorded at some time during the month in most of the States.

The lowest temperatures were generally recorded during the first decade and mainly in the early part. The minimum recorded, 7°, occurred at a point in the high mountains of Colorado, and temperatures below freezing were recorded in the elevated portions of practically all the western Mountain States and at exposed points in most States along the northern border.

Although there were no sharp falls in temperature the minimum readings on the 3d and 4th reached unusually low points in a few places, notably at New York, where the reading of 44° was the lowest ever observed in June, while Raleigh, N. C., with 49° on the 4th, had the lowest so late in the season.

PRECIPITATION

The total precipitation for the month was not excessive to any great extent though in parts of California it was unusually heavy for the time of the year locally in some of the northern sections. Generally speaking, precipitation was above normal in the East Gulf and South Atlantic States, in the Ohio Valley, the middle Plains, and in most of the far-western districts. It was less than normal in the Southwest and also over the Northeastern States and in the area between the upper Lakes and the Rocky Mountains, the deficiency becoming rather large over Minnesota, the Dakotas, Iowa and Wisconsin. No severe drought existed during the month over extensive areas, though the absence of sufficient precipitation was being felt in portions of the spring-wheat belt as the month closed.

SNOWFALL

Traces of snow only were reported from a few northern mountain States, but a total fall of 14 inches was recorded at a point in Wyoming.

RELATIVE HUMIDITY

Viewing the country as a whole there was a deficiency in the percentages of humidity over many sections, this being particularly large in portions of the Dakotas and some near-by areas, and also in most of the Southwest and in parts of the Northeast. There were some excesses in the Southeastern States, in the upper Lake region, in portions of the middle Plains, and locally in California and to the northward.

SEVERE LOCAL STORMS, JUNE, 1929

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Ross, Wyo. (near)	1	5:30 p. m.			$4,000	Hail and rain	Crops and roads damaged	Official, U. S. Weather Bureau.
Great Falls, Mont., and vicinity.	1	P. m.			2,000	Wind and rain	Circus tent, chimneys, and signs blown down; 2 planes, overhead wires and windows damaged.	Do.
Garden City, Tex.	2	3-6 p. m.				Hail	Severe crop loss	Do.
Center, Jud and Rule, Tex.	2	4 p. m.	6 mi.		29,000	Wind and hail	A series of storms killed livestock and poultry and damaged crops.	Do.
Ira and Dunn, Tex.	2	do.	4 mi.			Severe hail	Replanting of crops necessary	Do.
Barton and Rice Counties, Kans.	2	4-5 p. m.	880		110,000	Tornado and hail.	Greatest property damage near Claflin; wheat damaged by hail over path 10 by 30 miles.	Do.
Barber County, Kans.	2	5:15-5:45 p. m.	50		30,000	do.	Much farm property near Hartner damaged; injury by hail over area 8 by 12 miles.	Do.
Wichita, Kans.	2	6 p. m.	2 mi.		150,000	Wind	Chief damage to airplanes at airport; additional damage to oil rigs and buildings by tornadic winds.	Do.
Winters, Tex.	2		6 mi.			Heavy hail	Heavy crop damage	Do.
Lancaster, Tex.	3	5 p. m.	50		1,000	Tornado	Outbuildings and crops damaged	Do.
Roswell, N. Mex.	4		2,640			Heavy hail	Apples and young cotton damaged about 60 per cent. Path 12 miles.	Do.
Tahoka, Tex.	5	5 p. m.	4 mi.		49,000	Hail	Damage chiefly to crops; minor injury to buildings.	Do
Chugwater, Wyo.	5	5-6 p. m.			3,100	Heavy hail	Crops damaged	Do.
Fort Stockton, Tex. (near)	5	6 p. m.	3 mi.		60,000	do	Crops and buildings damaged	Do.
Plainview, Tex. (near)	5	do.	1,760			do	Severe crop loss	Do.
Fountain, Colo.	5	6:30-9:30 p. m.	8-10 mi.		250,000	Hail, wind, and rain.	Extensive damage of various kinds; poultry and livestock killed; 3 persons injured.	Do.
Chillicothe, Tex.	6	6 p. m.	4 mi.			Heavy hail	10,000 acres of cotton destroyed.	Do.
Flag, Olton, and Running Water, Tex.	6	7 p. m.	5 mi.	2	240,000	Wind	21 houses and many windmills and outbuildings demolished; livestock and poultry killed; 15 persons injured.	Do.
Plainview, Tex.	6	7:30 p. m.	2,640		100,000	Hail	Extensive damage to crops and other property	Do.
Kalispell, Mont., and vicinity.	8	P. m.			1,500	Wind	Damage chiefly to buildings; some plate-glass windows broken; trees and telephone poles leveled.	Do.
Campbell County, Va. (northern).	8	do.				Wind and hail	Several buildings unroofed; crops injured	Do.
Detroit Lakes, Minn.	9	do			200,000	Tornado	Many homes and farm buildings partially or completely destroyed. Probably 3 separate tornadoes	Do.
Roswell, N. Mex. (near)	9		1,760			Heavy hail	50 per cent of cotton in path destroyed	Do.
Stead, N. Mex. (near)	10	3 p. m.				Tornadic wind	Minor damage	Do.
Duluth, Minn., and vicinity.	10	4 p. m.				Heavy hail	Lights and windows broken; auto tops pierced and dented; several persons injured.	Do.
Bruce (near) to Minocqua, Wis.	10	6:30-7:30 p. m.	67-267		250,000	Tornado, hail and rain.	Residences, business houses, and garages damaged or wrecked; wire systems impaired; livestock killed; timber ruined; 13 persons injured.	Do.
Kingston, Minn. (near)	10	P. m.		2	250,000	Tornado	Many farm buildings and homes partially or totally demolished; crops beaten; path 20 miles long; many persons injured.	Do.
Beadle, Kingsbury, and Lake Counties, S. Dak.	11	3 a. m.			155,000	Wind	Severe property damage; damage by lightning in Huron.	Do.
Winneshiek County, Iowa.	11	10 a. m.			5,000	do	Minor property damage over path 3 miles long	Do.
Columbia County, Wis. (central).	11	11 a. m.		1	10,000	Severe squall	Buildings, silos and windmills damaged	Do.
Canning, S. Dak.	11	4 p. m.	880		10,000	Hail	Crops beaten and many windows broken	Do.
Kiowa County, Okla. (southwestern).	11	5-7 p. m.	1-3 mi.		30,000	Heavy hail	Crops damaged, light to total; several houses wrecked. Path 20 miles.	Do.
South Dakota (southeastern counties).	11	6:30-8 p. m.			310,000	Hail and wind	Extensive damage to crops, buildings and trees; telephone and telegraph companies suffer heavy loss.	Do.
Rankin, Tex.	11	6:40 p. m.	440		75,000	Wind	Much damage to water works, buildings and crops; 1 person injured.	Do.
Rawlin, Decatur, Norton, Haskell, Washington, Marshall, Russell and Lincoln Counties, Kans.	11	6-10:30 p. m.			470,000	Heavy hail	Wheat crops totally destroyed over wide area	Do.
Illinois (northern)	11			1	36,500	Severe thunderstorm and hail.	A number of buildings struck by lightning; stock killed; telephone and electric light service impaired at several points; roofs and greenhouses damaged.	Do.
Iowa (northern half)	11			1	1,500,000	Wind, hail, and floods.	Damage to crops enormous; considerable injury to property; area covered 25 counties.	Do.
Centralia, Danville, Quincy and Mount Carroll, Ill.	12	5:30-7:30 a. m.				Wind and hail	Crops and buildings damaged; grain flattened; overhead wires blown down.	Do.
Harvey and Butler Counties, Kans.	12	6-7 a. m.	2 mi.		150,000	Heavy hail	Much wheat destroyed; gardens laid waste; other property damage. Path 32 miles.	Do.
Marion, Ralls, and Monroe Counties, Mo.	12	A. m.			7,000	Wind	Farm buildings and implements damaged, a few wrecked; poultry killed.	Do.
Carl Junction, Mo.	12	P. m.	2 mi.		18,000	Heavy hail	Roofs and plate-glass windows damaged; crops badly injured.	Do.
Halltown and Paris Springs, Mo.	12	do.	5 mi.			do	Roofs and windows damaged; crops on a number of farms ruined.	Do.
Norton County, Kans.	13	4 p. m.	1,760		5,000	do	Damage chiefly to wheat over path 10 miles long.	Do.
Pawnee County, Kans.	13	5 p. m.	1,760		125,000	do	Much wheat a complete loss. Path 20 miles	Do.
Pratt County, Kans.	13	6:30-7:30 p. m.	1-4 mi.		500,000	do	Wheat damaged 20 to 50 per cent. Path 25 miles.	Do.
Grayson County, Ky.	13				10,000	Wind and hail	Roofs and timber damaged	Do.
Jefferson County, Ky.	13				10,000	do	Truck gardens, roofs and trees damaged	Do.
Licking County, Ohio	13-14				7,000	High wind	Telephone poles and trees prostrated; roofs damaged.	Do.
Philadelphia, Pa. (suburbs)	14	4:30 p. m.			10,000	Thunderstorm and wind.	Huge trees uprooted; windows broken; factory damaged by lightning.	Do.
Frederick, Okla. (near)	14	5 p. m.			5,000	Hail	Damage confined to crops	Do.
Newark, N. J. (Metropolitan Airport).	14	5:30-6:30 p. m.			11,000	Severe thunderstorms.	A number of planes damaged	Do.
Forsyth to Granville, N. C.	15		1,760		75,000	Heavy hail	Tobacco and other crops partly destroyed over path 10 miles long.	Do.
Monroe County to Sioux County, Iowa.	16	3-5 p. m.			750,000	Wind, hail, and flood.	Basements flooded; dwellings inundated; windows and roofs pierced; auto tops ruined.	Do.
Salt Lake City to Ogden, Utah.	16	P. m.				Wind and hail	30 ammunition magazines demolished; poles and wires blown down; crops severely damaged.	Do.
Sunbury, Pa.	16				25,000	Cloudburst	Silk mill stock nearly ruined; much damage by washouts and landslides; traffic delayed.	Do.

[1] Mi. signifies miles instead of yards.

Severe local storms, June, 1929—Continued

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Monroe County, Wis.	16, 18				$25,000	Heavy hail	Damage chiefly to strawberries	Official, U. S. Weather Bureau.
Sundance, Wyo.	17	5:15 p. m.				Tornado	No damage reported	Do.
Dickinson County, Kans.	18	12:30 a. m.	3-6 mi.		150,000	Heavy hail	Extensive crop damage over a 30-mile path	Do.
Little York and Pine Island, N. Y.	18	3:30 p. m.	300		15,000	do	Onion and lettuce crops badly injured	Do.
Geneva, Nebr.	18	8 p. m.	3 mi.		500,000	do	Loss of crops 25 per cent to total. Path 20 miles	Do.
Louisville, Ky.	18				25,000	Electrical	An apartment house wrecked	Do.
Hillsboro, Wis. (near)	18	P. m.	1,760		40,000	Wind	Severe damage to houses, farm buildings, and trees; livestock killed.	Do.
Prince Georges County, Md. (northwestern).	19	12:30 p. m.	3-4 mi.			Heavy hail	Fruits and tomatoes injured	Do.
New Castle, Pa. (near)	19	3 p. m.				Heavy hail and wind.	A church badly damaged; cherry crop ruined	Do.
West Bloomfield, N. Y. (near).	19	3-3:20 p. m.	3 mi.			Heavy hail	Considerable fruit damage	Do.
Trumbull, Nebr.	19	6:15 p. m.	25 mi.		25,000	do	Farm property and crops considerably damaged over area 25 miles square; poultry and pigs killed.	Do.
Oxford, Nebr.	19	6:30 p. m.	3 mi.		26,000	do	Crops and windows damaged. Path 12 miles	Do.
Nebraska (southeastern)	19	7:30-9:30 p. m.	20 mi.	2	2,000,000	Wind and hail	Many farm buildings wrecked or damaged; trees uprooted; crops devastated; poultry killed; wind tornadic in places. Path 60 miles.	Do.
Marshall County, Kans.	19	10 p. m.			10,000	Wind	Damage chiefly to power and telephone lines and small buildings.	Do.
Claysville, Pa.	19	P. m.			10,000	Hail and wind	1 barn and contents destroyed; crops injured	Do.
Lancaster, Pa., and vicinity.	19	do			17,000	do	4 barns wrecked; trees uprooted	Do.
Stewartsville to Kingston, Mo.	19	do			2,000	Tornadic wind	House moved on foundation; small trees broken; windmills wrecked.	Do.
Saline and Ottawa Counties, Kans.	19-20		15 mi.		45,000	Wind	Much damage to buildings and wires. Path 20 miles long.	Do.
Dickinson County, Kans.	20	2 a m.	2 mi.		5,000	do	A school building and residences damaged; wire communication interrupted.	Do.
Gracemont, Okla., and vicinity.	20	5:30-6 p.m.	10 mi.		75,000	Hail and wind	Damage almost entirely to crops	Do.
Fort Cobb, Okla.	20	6 p. m.	1-3 mi.		25,000	do	Character of damage not reported	Do.
Harrisburg, Pa. (near)	20	P. m.			10,000	Thunderstorm, and hail.	Several buildings struck by lightning, 1 totally destroyed.	Do.
Snyder County, Pa.	20				10,000	Wind and thunderstorm.	A barn wrecked and livestock killed	Do.
Johnstown, Pa.	21	5:30 p. m.				Hail and rain	Several bridges washed away; heavy crop damage.	Do.
Wakefield, Nebr.	21	5:30 p. m.	4 mi.		75,000	Hail	Extensive crop damage; windows broken; poultry killed. Path 5 miles.	Do.
Saunders County, Nebr.	21	7:31 p. m.	3 mi.		25,000	do	Crops damaged	Do.
Ashland, Nebr.	21	8:30 p. m.	10 mi.		100,000	Wind	Many farm buildings damaged; crops injured; trees uprooted. Path 10 miles.	Do.
Weeping Water, Nebr.	21	9-9:31 p. m.			25,000	Hail	Considerable crop damage	Do.
Doniphan County, Kans.	21	11:30 p. m.				Heavy hail	Heavy crop damage	Do.
Lake Overholser, Okla.	21	do	440		3,000	Wind	Small frame cottages wrecked; others moved from foundations; several persons injured.	Do.
Morrill, Kans. (near)	22	2-5 a. m.	2 mi.		20,000	Hail	Crops injured over path 5 miles long	Do.
Brown, Doniphan, and Atchison Counties, Kans.	22	5:30 a. m.	1-8 mi.		[2] 220,000	Heavy hail	Extensive crop damage	Do.
Topeka, Kans.	22	8:33 a. m.				Small tornado	Minor damage to shade trees	Do.
Buchanan County, Mo.	22					Hail and rain	Heavy loss to crops, bridges, etc., fruit trees stripped; many homes flooded.	Do.
Marshall County, Tenn.	22		2 mi.		10,000	Hail	Crops hurt	Do.
Logan, Ohio (near)	22-23					Wind	2 homes wrecked, 5 damaged	Do.
Indiana County, Pa. (central).	23	2:30 p. m.			40,000	Wind and rain	Airplane hangar destroyed, other property damaged by landslides.	Do.
Flemming, Colo.	23	4 p. m.	6 mi.		300,000	Hail, wind, and rain.	Extensive crop and property damage	Do.
Peetz, Colo. (near)	23	4:30 p. m.	2-3 mi.		25,000	do	Wheat and barley crops damaged	Do.
Cheyenne County, Nebr.	23	6 p. m.			9,000	Hail	Heavy damage to crops in places. Path 10 miles.	Do.
Angola, N. Y.	23				10,000	Wind squall	2 barns wrecked; orchards damaged; telephone wires blown down.	Do.
Mifflin, Pa.	23	P. m.				Cloudburst and wind.	Concrete dam wrecked	Do.
Centerville, N. Mex. (near).	24	9-9:30 p.m.	10 mi.		7,500	Heavy hail	Crops damaged	Do.
Burwell, Nebr.	25	3 p. m.	9 mi.		25,000	do	Crops, trees, gardens, and fruits injured	Do.
Platte County, Nebr. (northern).	26	6:30-7 p.m.	3 mi.		60,000	do	Crops injured; buildings damaged. Path 17 miles.	Do.
Shelby, Nebr.	26	7 p. m.	3 mi.		10,000	do	Damage confined to crops and gardens. Path 3 miles.	Do.
Grant, Lafayette, Green and Rock Counties, Wis.	27		1,760		25,000	do	Property and growing crops damaged. Path 75 miles.	Do.
Iowa (14 counties)	27					Hail and wind	Crops and buildings damaged; 1 person injured	Do.
Jo Daviess County, Ill.	27		6 mi.		35,000	Hail	Crops and buildings damaged; poultry and pigs on several farms killed. Path 10 miles.	Do.
Noble, Steuben and Lagrange Counties, Ind.	27	P. m.			100,000	Wind	Character of damage not reported	Do.
Branch, Hillsdale and Lenawee Counties, Mich.	27-28				75,000	High winds and a tornado.	Many buildings wrecked; farm homes and barns more or less damaged; tornado in Branch County.	Do.
Farmington, Pa.	28	8:15 a. m.			25,000	Tornado	Every house in village wrecked or damaged; 3 persons injured.	Do.
Cheyenne County, Kans.	28	6-7 p. m.			25,000	Heavy hail	Crops damaged	Do.
Kane County, Pa.	28	P. m.			150,000	Wind and rain	Several houses unroofed; small buildings demolished; many telephone poles and trees blown down.	Do.
Fayette County, Iowa	28				11,000	Hail and wind	Crops damaged	Do.
San Antonio, Tex. (vicinity of).	28	P. m.			150,000	Wind	Corn and cane flattened; poles, wires, trees, signs, and light buildings blown down.	Do.
El Paso, Tex.	29	8 p. m.			3,000	do	Roofs and plate glass damaged	Do.
Stone Lake, Wis. (near)	29	do			12,000	Small tornado	Character of damage not reported	Do.
Washburn County, Wis. (central).	29	7 p. m.	440		10,000	Severe squall	Farm property damaged	Do.
Vermillion County, Ill.	30	5:30 p. m.	½-8 mi.		25,000	Wind	Barns blown down; trees and roofs damaged; some injury to crops.	Do.
Burnett and Washburn Counties, Wis.	30	7:30 p. m.			5,000	Hail	Crops damaged	Do.

[2] Includes damage in Doniphan County, Kans., on the 21st.

RIVERS AND FLOODS

By R. E. SPENCER

Losses in the Colorado, Guadalupe, and Nueces River floods, which had not been determined in time for inclusion with the discussion of the central and east Texas floods of late May in the REVIEW for that month, are reported as follows:

River	Reported loss	Savings through flood warnings
Colorado	$445,700	$143,000
Guadalupe	450,000	150,000
Nueces	([1])	

[1] None of importance.

Losses for March, April, and May in the Cairo, Ill., district, in addition to those already published for the flood of the lower Tennessee River in March, and which had been undetermined at the time of issue of the May REVIEW, are estimated at $1,110,950, distributed as follows:

Tangible property	$143,050
Matured crops	10,900
Prospective crops	802,000
Livestock and other movable property	34,100
Suspension of business	120,900
Total	1,110,950

Value of property saved through flood warnings, $161,000.

During June, floods of some importance occurred in the lower Missouri River and in the Grand River of Missouri, the latter having been exceptionally high. In the Missouri flood the losses amounted to $265,000, $212,000 of which was in prospective crops, and practically all occurred above Waverly, Mo. In the same area a saving of $40,000 was accomplished through the flood warnings. At and below Waverly and along the Grand River, crops had been ruined by the earlier rises of this spring, and the main damage this month consisted in the prevention of planting by the wet ground. Some railroad losses occurred in the Grand Basin.

The Illinois River flood, a rapid but not particularly high rise following excessive rains on the 14th–15th, was without important consequence beyond the usual inconvenience and a further delay in crop planting.

A crop loss of $15,000 occurred in the Solomon River Basin; and considerable inconvenience was experienced in other localities in Kansas from overflows from small streams—Big Stranger Creek particularly. In general these latter floods were the consequences of heavy local rains and were of short duration. A saving of $5,000 worth of property was accomplished in Kansas through Weather Bureau flood warnings.

Excepting that in the lower Mississippi, other floods in June were unimportant. Report on the lower Mississippi flood will appear in the July issue of this REVIEW.

[All dates in June unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE					
Neuse:	*Feet*			*Feet*	
Neuse, N. C.	15	29	([1])	16.2	30.
Smithfield, N. C.	14	30	([1])	17.0	July 2.
Santee:					
Rimini, S. C.	12	([2])	1	17.7	May 6.
		16	22	12.7	19.
		28	([1])	13.9	29.
Ferguson, S. C.	12	([2])	9	17.5	Mar. 10.
		14	15	12.0	14–15.
		18	([1])	12.7	30.
Jamestown, S. C.	12	([2])	13	17.4	May 11–13.
MISSISSIPPI DRAINAGE					
Ohio:					
Dam No. 50, Fords Ferry, Ky.	35	([2])	1	41.0	May 17–19.
Cairo, Ill.	45	([2])	1	52.7	May 19.
Wabash: Covington, Ind.	16	13	14	17.0	14.
Mississippi:					
Alton, Ill.	21	5	11	23.0	9.
St. Louis, Mo.	30	7	10	30.8	9.
Chester, Ill.	27	6	12	29.0	10.
Cape Girardeau, Mo.	30	6	15	33.0	10–11.
New Madrid, Mo.	34	([2])	4	41.3	May 19, 20, 23, 24.
Memphis, Tenn.	35	([2])	7	41.7	May 26.
Helena, Ark.	44	([2])	12	52.6	May 28–30.
Arkansas City, Ark.	48	([2])	21	58.8	May 29–31.
Greenville, Miss.	42	([2])	21	53.2	May 29–June 2.
Vicksburg, Miss.	45	([2])	29	55.2	6–7.
Natchez, Miss.	46	([2])	30	54.5	5–11.
Angola, La.	45	([2])	([1])	52.4	8–13.
Baton Rouge, La.	35	([2])	([1])	43.5	10–13.
Donaldsonville, La.	28	([2])	([1])	34.0	10.
Reserve, La.	22	([2])	([1])	25.9	11.
New Orleans, La.	17	([2])	([1])	20.0	9.
Illinois:					
Peru, Ill.	14	12	29	17.7	15.
Henry, Ill.	10	15	24	11.6	18.
Peoria, Ill.	18	18	21	18.2	19.
Havana, Ill.	14	([2])	8	19.6	Apr. 6.
		14	29	15.3	21.
Beardstown, Ill.	14	([2])	([1])	21.2	Apr. 6.
Pearl, Ill.	12	([2])	27	21.3	Apr. 29–30.
St. Francis:					
St. Francis, Ark.	18	19	22	19.1	21.
Marked Tree, Ark.	17	([2])	2	17.5	May 28–29.
Missouri:					
Kansas City, Mo.	22	3	6	23.4	5.
		23	24	22.3	23.
Waverly, Mo.	23	3	11	25.0	6.
		23	25	24.2	24.
Boonville, Mo.	21	4	10	23.7	7.
Hermann, Mo.	21	4	11	24.8	8.
		26	26	21.0	26.
St. Charles, Mo.	25	4	14	31.4	9.
		25	28	26.5	26–27.
Smoky Hill: Mentor, Kans.	22	4	4	22.1	4.
Solomon: Beloit, Kans.	18	8	9	26.5	9.
Grand:					
Gallatin, Mo.	20	1	5	37.7	2.
Chillicothe, Mo.	18	1	7	32.1	3.
Brunswick, Mo.	12	3	11	19.4	6.
		24	26	13.1	25.
Grand, Thompsons Fork: Trenton, Mo.	20	2	3	31.4	2.
Arkansas: Yancopin, Ark.	29	([2])	([1])	44.8	May 28–30.
Little Arkansas: Sedgwick, Kans.	18	4	4	18.5	4.
White:					
Georgetown, Ark.	22	([2])	12	26.3	May 17–18.
Clarendon, Ark.	30	([2])	2	31.3	May 24–25.
Black:					
Poplar Bluff, Mo.	14	15	16	14.4	15.
Corning, Ark.	11	17	25	12.5	21.
Black Rock, Ark.	14	([2])	1	22.3	May 20.
Yazoo: Yazoo City, Miss.	25	([2])	25	29.7	May 1.
Atchafalaya:					
Simmesport, La.	41	([2])	([1])	46.4	12–16.
Melville, La.	37	([2])	([1])	42.2	9–16.
WEST GULF DRAINAGE					
Sabine:					
Logansport, La.	25	10	12	25.2	10–11.
Bon Wier, Tex.	20	2	3	20.2	3.
Orange, Tex.	4	2	5	4.3	4.

[1] Continued at end of month. [2] Continued from last month.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Neches:					
Rockland, Tex	22	(2)	6	26.8	1.
Beaumont, Tex	7	(2)	13	13.4	2.
Trinity:					
Dallas, Tex	25	(2)	7	34.5	May 17.
Trinidad, Tex	28	(2)	11	39.6	May 22.
Long Lake, Tex	40	(2)	12	45.2	3.
Riverside, Tex	40	(2)	4	46.2	1.
Liberty, Tex	25	(2)	22	28.3	2.
Brazos:					
Washington, Tex	45	(2)	5	51.0	1.
Hempstead, Tex	40	May 31	5	43.8	2.
Rosenberg, Tex	40	2	8	46.2	6.
Freeport, Tex	4	5	12	7.4	10.
Colorado: Columbus, Tex	28	(2)	3	38.0	1.
Guadalupe:					
Gonzales, Tex	22	(2)	2	34.0	May 29.
Victoria, Tex	16	(2)	6	26.2	2.
Nueces: Three Rivers, Tex	37	(2)	4	42.0	May 31.
Rio Grande: San Marcial, N. Mex	3	(2)	4	4.2	May 23–25.
PACIFIC DRAINAGE					
Colorado:					
Fruita, Colo	12	3	12	13.2	4.
Parker, Ariz	7	(2)	(1)	11.9	2.
Colorado, Roaring Fork: Carbondale, Colo	5	2	12	6.1	9.
		14	15	5.4	15.
		20	24	5.2	21–22.
Eagle: Eagle, Colo	5	2	11	6.1	10.
Gunnison: Delta, Colo	9	(2)	18	11.7	May 26.
		22	23	9.0	22–23.
Columbia:					
Marcus, Wash	24	6	27	27.8	17.
Vancouver, Wash	15	12	26	17.7	20.

[1] Continued at end of month. [2] Continued from last month.

THE EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, JUNE, 1929

By W. A. MATTICE

General summary.—During the first decade continued cool weather retarded the growth of warm-weather crops east of the Mississippi River, but there was a favorable warming up toward the close of the period. The weather was mostly favorable in the South, while in the west Gulf area farm work and crops advanced satisfactorily under beneficial conditions. In some interior sections the soil continued too wet to work, but in the northern Great Plains the weather favored agricultural interests; rain was needed in an extensive area of the North from northeastern Iowa and Wisconsin eastward. In the far Northwest local showers or generous rains were helpful, especially for the grain crops, but there was considerable damage to cherries and mown hay in northern California, while moisture was needed badly in the Great Basin and much of New Mexico.

During the second decade further rains in some persistently wet sections were detrimental, but the weather in general was largely favorable for agricultural interests. Showers were helpful in the Lake region, while in the South temperature conditions were beneficial and ideal weather for ripening grains and for harvest prevailed in the Southwest. In the central and northern Great Plains growth was rapid, but it continued dry in the far Southwest, while rains were helpful in the Great Basin and the far Northwest.

During the last decade droughty conditions were relieved in the Northeast but night temperatures were rather too cool for best growth of warm-weather vegetation from the Ohio Valley northward, otherwise warmth was sufficient and crops made satisfactory advance. Timely and beneficial rains occurred in the upper Mississippi Valley, but drought prevailed and rainfall was badly needed in a rather extensive area of the Northwest, including the principal spring-wheat sections, where grains were heading short; rain was also needed in the far Southwest.

Small grains.—During the first decade winter wheat showed improvement in the Ohio Valley, with the general condition good to excellent; the crop was heading in many parts and some ripening was reported. In the trans-Mississippi States wheat did well and in the Great Plains satisfactory advance was made; progress and condition were mostly fair to good, except that poor condition was indicated over large areas of Oklahoma and there was some rust and lodging in Kansas. Favorable conditions prevailed elsewhere. During the second decade winter wheat heading became general in the Ohio Valley and harvest had begun in the lower valley districts. Very good to excellent conditions prevailed in the Great Plains, with the crop heading in South Dakota; ideal harvest weather prevailed in most of the Southwest, with rapid advance in this work. During the last decade conditions were mostly favorable for harvesting wheat in the Ohio Valley, with this work general to the central portions; the crop was turning in Iowa, while harvest was rather general in the south-central Great Plains and in the Southwest under mostly favorable conditions.

Spring wheat made good advance generally during the first two decades, except for some local dryness, but toward the close of the month, droughty conditions prevailed in much of the northern belt, with deterioration noted in many parts, especially in Montana where the crop was backward and burning locally. Oats did well generally, except in the Ohio Valley and some central sections, where they were heading on short straw. Other small grains mostly did well except toward the close of the month rain was needed in the northern Great Plains.

Corn.—During the first decade conditions were fairly favorable for field work in the Corn Belt, except that in some persistently wet sections soggy fields prevented active operations with considerable corn not yet planted. Elsewhere planting was largely completed, but in the eastern part of the belt cool weather was unfavorable for germination. In Iowa progress and condition were generally fair, but the crop was very irregular, while conditions were mostly favorable in the Plains States. During the second decade further rains were detrimental in preventing completion of planting in the central belt, but in the upper Ohio Valley rains and warm weather were beneficial and in the western half of the belt conditions were largely favorable. Progress and condition were still mostly fair in Iowa, while in the Plains the period was again favorable. During the last decade the crop continued generally late and very uneven, especially in Iowa, where it ranged from shoulder high to a few inches tall. It was rather cool for best growth, but advance was generally favored, while in Iowa rains were beneficial and progress was very good to excellent; growth was satisfactory elsewhere.

Cotton.—During the first decade there was some interruption to field work in the Atlantic States and general coolness east of the Mississippi River retarded growth, but the general progress of cotton was fair to fairly good, with squares and blooms increasing rapidly in southern parts and local bloom to South Carolina. The weather was mostly favorable in Arkansas and Louisiana, while moderate warmth and much sunshine permitted resumption of cultivation and chopping in Texas, where growth was good, but in Oklahoma it continued too wet in the central and eastern portions, where progress was poor to only fair, but good advance was noted elsewhere. During the second decade good growth was possible in

the Atlantic States and fields were clean and well cultivated, but in the central Gulf area it was rather too cool for best growth, although good progress was made. Conditions were generally favorable in Tennessee, Arkansas, and Louisiana, with good to excellent growth noted, while in Oklahoma adequate warmth and sunshine were very helpful, although there were still reports of grass and weeds in the east. General condition was spotted in Texas, but growth was very good under favorable weather and squares were forming to central parts, while a small amount of cotton was marketed in the South.

During the last decade there was too much rain in most sections of the Atlantic States, which hindered cultivation and favored increased weevil activity and there were complaints of fields becoming weedy and plants not fruiting well. In the central Gulf area progress was fair to excellent, but there was too frequent rain locally, although some States had dry, sunny weather, which was excellent for growth and checking weevil. The weather was also mostly favorable in Oklahoma and Texas, with picking progressing in southern Texas.

Miscellaneous crops.—Ranges, pastures, and meadows did well in most sections east of the Rocky Mountains, except for some local dryness in the Lake region and rather extensive need of moisture in the northern Great Plains. Local areas west of the Rockies also needed a replenishment of water supplies, but range feed still appeared ample and livestock were mostly thriving. Sheep shearing had been completed in many parts by the close of the month.

Potatoes made satisfactory advance and truck crops were largely in good condition, except that cool nights retarded growth locally. Tobacco curing became general in the Southeast and growth and cultivation were satisfactory in Kentucky at the close of the month. Sugar beets continued to do well throughout the month, while sugar cane was thriving generally. Citrus groves were in excellent condition in Florida, with the fruit holding well, and oranges were excellent in California.

WEATHER OF THE ATLANTIC AND PACIFIC OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

June, 1929, lived up to its reputation as being one of the quietest months of the year over the North Atlantic, and gales were not observed in more than four days in any 5° square, the maximum occurring in the square between the forty-fifth and fiftieth parallels and twenty-fifth and thirtieth meridians. About the only unusual feature was a tropical disturbance during the latter part of the month; that will be referred to later. As shown by Table 1, there were no unusually large departures, and the pressure distribution, as a whole, did not differ greatly from the normal.

Fog was unusually prevalent over the greater part of the ocean and was reported on from 17 to 21 days between the fortieth and forty-fifth parallels, west of the forty-fifth meridian. Fog was also observed from 8 to 12 days over the middle and eastern sections of the steamer lanes, from 3 to 5 days along the European coast, and on 9 days along the American coast, between Hatteras and New York.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, 8 a. m. (seventy-fifth meridian). North Atlantic Ocean, June, 1929*

Stations	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.90	(1)	30.20	21st [2]	29.64	9th.
Belle Isle, Newfoundland	29.86	[3] +0.02	30.26	6th [2]	29.38	18th.
Halifax, Nova Scotia	29.94	[4] −0.03	30.24	23d	29.60	1st.[2]
Nantucket	29.94	[4] −0.06	30.12	9th	29.58	29th.
Hatteras	29.98	[4] −0.04	30.20	17th	29.66	10th.
Key West	29.97	[4] −0.02	30.12	14th	29.84	10th.
New Orleans	29.96	[4] −0.04	30.16	31st	29.82	2d.
Cape Gracias, Nicaragua	29.88	[3] −0.04	29.96	13th	29.82	11th.[2]
Turks Island	30.09	[4] +0.06	30.16	13th [2]	30.00	4th.[2]
Bermuda	30.19	[4] +0.06	30.42	13th [2]	29.90	3d.
Horta, Azores	30.17	[3] −0.04	30.46	21st	29.76	27th.
Lerwick, Shetland Islands	29.83	[3] +0.03	30.21	28th	29.34	6th.
Valencia, Ireland	30.03	[3] +0.03	30.60	21st	29.46	6th.
London	30.02	[3] +0.09	30.46	21st	29.41	6th.

[1] No normal available.
[2] And on other date or dates.
[3] From normals shown on Hydrographic Office Pilot Chart, based on observations at Greenwich mean noon, or 7 a. m. seventy-fifth meridian.
[4] From normals based on 8 a. m. observations.

On May 30 and 31 a well-developed disturbance was central near 45° N., 35° W. This LOW moved slowly toward the NNE., decreasing in intensity, and on June 1 the center was near 50° N., 31° W., with moderate easterly and southerly gales in the northern and eastern quadrants, respectively. On the 1st the station at Horta, Azores, reported a southerly wind, force 8, and vessels in the vicinity encountered southwesterly to southerly winds, force 6 to 7.

From the 2d to 7th the conditions over the ocean were, as a rule, comparatively featureless, with moderate winds prevailing, except that on the 3d a slight depression of limited extent was in the vicinity of the Bermudas, and on the 4th northeast winds of force 7 to 8 were reported off the American coast between Jacksonville and Charleston, while on the 5th southerly to southwesterly winds of force 7 were encountered over a limited area in the middle section of the southern steamer lanes.

On the 10th a moderate LOW was central about 200 miles east of Halifax, and on the 11th was about the same distance east of Nantucket. On the 10th and 11th there was also a disturbance near the fiftieth parallel between the twentieth and thirty-fifth meridians.

Charts VIII to XI show the conditions from the 12th to 15th, inclusive, and give an idea of the weather encountered by the airplane *Yellow Bird*, that took off from Old Orchard Beach on the morning of the 13th, and landed on the beach near Santandar, Spain, late in the afternoon of the 14th.

From the 16th to 24th there ensued another period of comparatively favorable weather and slight pressure gradients over the ocean as a whole, although on the 19th Belle Isle, Newfoundland, reported a northerly wind, force 9, with rain, and barometer reading of 29.46 inches.

On the 25th there appeared in the middle section of the Gulf of Mexico the first tropical disturbance of the season. This was of limited extent and for the most part, of comparatively slight intensity, as it moved slowly westward, being on the 28th central near Brownsville, Tex. Up to the time of writing the American steamships *Trinidadian* and *Gulfoil* were the only vessels to render regular storm reports relating to this disturb-

ance. Vessels near by apparently encountered moderate weather only. However Capt. C. V. Nissen of the American steamship *Mexoil*, from New Orleans to Tampico, forwarded a special report in which he states that on June 27, 9 p. m., in 25° 18′ N., 93° 46′ W. he encountered this storm, and estimated the strength of wind in squalls at 80 miles an hour. The lowest barometer was 29.56 (uncorrected) at 2 a. m. on the 28th, wind SE., 8 to 10, heavy rain squalls, wind of hurricane force. End of gale, 8 a. m. on the 28th, wind S., 6. Sea moderating.

On the 26th a moderate depression was over the middle section of the steamer lanes; this moved rapidly eastward, and on the 27th was central near 46° N., 25° W. On the 27th there was also a depression over Newfoundland and moderate southerly gales prevailed between the Bermudas and fortieth parallel.

For the remainder of the month moderate weather was the rule over the ocean as a whole, although a few vessels in widely scattered localities reported winds of force 7 and 8.

OCEAN GALES AND STORMS, JUNE, 1929

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				Inches					
Saguache, Am. S. S.	New York	Copenhagen	53 06 N	31 11 W	May 31	June 1	June 1	28.87	ENE	ENE, 7	ESE	—, 9	ENE-E.
Examelia, Am. S. S.	Mediterranean.	New York	39 27 N	25 52 W	31	—, 1	2	30.00	SSW	SSW, 8	W	SSW, 8	
Cornelia, Am. S. S.	New York	Porto Rico	32 20 N	70 40 W	June 10	8 a, 10	10	29.66	S	S, 8	SSW	S, 8	S-SSW.
New York City, Br. S. S.	Fowey, England.	Portland, Me.	51 20 N	31 15 W	9	8 a, 10	12	29.39	SSW	WSW, 7	NNW	—, 9	S-W.
Exhibitor, Am. S. S.	Marseille	Boston	41 35 N	51 20 W	12	Noon, 12	12	29.78	SW	WSW, 7	WNW	WNW, 8	WSW-W.
Coahoma County, Am. S. S.	Rotterdam	New York	48 48 N	17 15 W	11	Noon, 12	14	29.82	SW	SW, 8	SW	WSW, 9	W-SW.
München, Ger. S. S.	New York	Southampton.	48 56 N	18 33 W	11	—, 13	14	29.65	WSW	W, 10	W	W, 10	W-NNW.
Middleham Castle, Br. S. S.	Galveston	Havre	41 01 N	36 30 W	12	4 a, 15	17	29.96	SW	NNE, 6	NNE	NE, 8	
Trinidadian, Am. S. S.	Tampa	Port Arthur	28 16 N	88 03 W	24	11 p., 24	25	29.92	S	S, 7	S	S, 9	Steady.
Bird City, Am. S. S.	New York	Copenhagen	46 16 N	41 23 W	25	4 p., 25	27	29.66	W	W, 6	NNW	NNW, 8	NNW-E.
Wm. G. Warden, Am. S. S.	Montreal	Corpus Christi.	38 51 N	62 18 W	26	Noon, 26	27	30.01	SW	SW, 8	SW	SW, 8	Steady.
Gulfoil, Am. S. S.	Port Arthur	Philadelphia	29 24 N	93 28 W	28	8 p., 28	28	29.93	SE	SE	SE	SE, 8	Do.
NORTH PACIFIC OCEAN													
Corinto, Am. S. S.	San Francisco	Cristobal	16 22 N	99 46 W	1	1 p, 1	1	29.52	NW	W, 9	SW	WSW, 10	NW-W-SW.
Mojave, Am. S. S.	San Pedro	Nagasaki	30 58 N	141 02 E	1	4 p, 1	1	29.45	S	SSW, 11	SW	SSW, 11	SSE-SW.
Havana Maru, Jap. S. S.	do	Yokohama	33 30 N	142 00 E	1	8 p, 1	2	29.41	E	NE, 8	SE	NNE, 10	ENE-NE-N.
Wisconsin, Am. S. S.	Hong Kong	San Francisco	30 30 N	132 50 E	5	1 p, 5	5	29.51	SSE	SSE, 7	SSW	SSW, 9	SSE-SSW.
Ayaha Maru, Jap. S. S.	Yokohama	Victoria	39 28 N	148.00 E	6	10 p, 6	7	29.10	E	ENE, 8	NNW	ENE, 8	6 points.
Golden Star, Am. S. S.	Otaru	San Francisco	49 26 N	178 36 W	5	12 mdt	6	29.20	WSW	NW, 7	SSW	SW, 9	
Do	do	do	48 47 N	159 54 W	7	1 a, 8	9	29.27	E	SW, 7	SE	SW, 9	
Clydefield, Br. M. S.	San Pedro	North China	35 15 N	159 45 E	7	4 a, 8	9	29.82	SSW	W, 8	NW	S, 8	SW-W-NW.
Manoa, Am. S. S.	San Francisco	Honolulu	37 34 N	123 18 W	12	4 p, 12	12	30.02	N	N, 8	NNW	N, 8	N-NNW.
Silverguava, Br. M. S.	do	Yokohama	41 30 N	132 20 W	15	10 a, 15	16	29.67	SSW	SSW, 6	W	W, 8	
Victorious, Am. S. S.	Honolulu	Colon	14 08 N	103 20 W	16	4 p, 16	17	29.66	NNE	E, 9	SSE	E, 10	Steady.
City of Victoria, Can. S. S.	Tsugaru Sts.	San Francisco	42 22 N	153 00 E	19	2 p, 19	19	29.02	SE	SSE, 7	W	SSE, 8	SE-S-WSW.
Boren, Swed. S. S.	Manila	do	44 21 N	140 44 E	21	Noon, 22	22	29.92	ESE	SSE, 8	S	SE, 9	ESE-S.
Grays Harbor, Am. S. S.	Puget Sound	Yokohama	42 15 N	149 30 E	16	10 p, 16	17	29.17	ESE	SSW, 8	SW	SE, 9	S-SSW-SW.
SOUTH PACIFIC OCEAN													
Maunganui, Br. S. S.	New Zealand	Sydney, N. S. W.	36 02 S	154 30 E	9	4 p, 9	10	29.46	W	SSW, 8	SSW	SW, 9	S-SSW-SW.
SOUTH ATLANTIC OCEAN													
Nevada, Dan. S. S.	Rotterdam	Buenos Aires	34 30 S	53 12 W	11	8 p, 11	12	29.60	E	SSE, 9	SSW	SW, 10	E-SSE-SW.
Vandyck, Br. S. S.	New York	Montevideo	28 41 S	47 21 W	12	8 p, 12	13	29.93	SW	SW, 8	SSW	W, 9	

NORTH PACIFIC OCEAN

By WILLIS E. HURD

The conditions of atmospheric pressure in June had changed but little from those prevailing in May, except that as a rule the average barometric readings were somewhat lower over the eastern part of the ocean, St. Paul, in the Bering Sea, being the only station, among those given in Table 1, with pressure higher than in the preceding month. The Aleutian cyclone was well developed for the season; it was centered in its fluctuations principally near or south of Dutch Harbor, though on several days it lay over the Gulf of Alaska. On a few days of the month, during incursions southward from the gulf, it affected the weather along the Washington, Oregon, and upper California coasts, causing a few moderate to fresh gales in the vicinity.

Owing to the persistence of the Pacific-California HIGH, fine anticyclonic weather prevailed along the greater part of the steamer routes between the United States and the Hawaiian Islands, except east of the one hundred and thirty-fifth meridian, where fog was frequent.

Barometric data for several island and mainland coast stations in west longitudes are given in the following table:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean and adjacent waters, June, 1929*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	Inch	Inches		Inches	
Point Barrow [1]						
Dutch Harbor [2] [3]	29.65	−0.34	29.96	20th	29.06	9th.
St. Paul [2]	29.81	−0.08	30.18	29th	29.34	9th.
Kodiak [2]	29.81	−0.13	30.46	2d	29.32	12th.
Midway Island [2] [4]	30.13	+0.06	30.32	29th	29.86	2d.
Honolulu [5]	30.04	0.00	30.14	10th	29.90	21st.
Juneau [5]	29.90	−0.11	30.35	22d	29.32	15th.
Tatoosh Island [5] [6]	30.00	−0.05	30.49	19th	29.38	15th.
San Francisco [5] [6]	29.95	−0.01	30.22	18th	29.70	23d.
San Diego [5] [6]	29.91	+0.02	30.08	9th	29.75	27th.

[1] Data insufficient to use.
[2] P. m. observations only.
[3] For 23 days.
[4] For 25 days.
[5] A. m. and p. m. observations.
[6] Corrected to 24-hour mean.

Gale weather moderated over the North Pacific to only a slight extent during June, as compared with that of May, although gales were scattered and few exceeded force 9. Such as were of force 8 and upward were reported on 13 days. The region of most frequent storminess lay east and south of Japan, where numerous depressions and cyclones from both tropical oceanic and middle and upper continental sources occurred. Other gales were reported from the west coasts of Mexico and the United States, and on two or three occasions in upper midocean. The only instances of whole to storm gales were those associated with storms of the tropics.

From the 1st to the 7th of June at least two typhoons occurred in the waters of the Far East. One, which originated in May in low latitudes, skirted the southeast coast of Japan late on June 1 and disappeared at sea far east of the Kuril Islands on the 3d. This typhoon attained to at least storm force on the 1st, the American tanker *Mojave* encountering southwesterly gales of force 11, during the afternoon, near 31° N., 141° E., lowest pressure 29.45. The Japanese steamer *Havana Maru* on the same day, in 33° 30′ N., 142° E., reported a whole gale from north-northeast, barometer 29.41 inches.

The second typhoon remained in the upper part of the China Sea from the 1st to the 4th, when it turned oceanward between China and Luzon and, crossing Taiwan, continued northeastward. On the 5th and 6th it proceeded over the lower islands of Japan and entered upon the ocean. The bureau has no record of severe gales attending its progress. However, while in the China Sea on the 2d to 4th, the Dutch steamer *Kertosono* was under the southward influence of the typhoon, though it was not until the 4th that she ran into moderate southwesterly gales at the rear of the retreating storm, barometer 29.73, in 12° 57′ N., 116° 27′ E. The following is an extract from a radiogram sent to the department of terrestrial magnetism, Carnegie Institution, on June 2 by Capt. J. P. Ault of the American nonmagnetic yacht *Carnegie*, with reference to this disturbance:

Dodged typhoon night of June 1–2. Barometer was dropping rapidly and wind and sea increasing. The storm center position for the previous two days received by radio from the Manila observatory was immediately plotted and path predicted as about to intercept our track. We at once headed out toward east by south and as we drew away from the center of the storm the barometer rose slowly and wind moderated. We ran for two hours and then hove to and waited for wind to moderate for another two hours. We then set sail on course for Yokohama, riding the tail of the typhoon. The wind continued to shift slowly to the right as the storm receded from us toward the northeast. This was our first experience in handling a storm by radio, and everything went like clockwork and exactly as we predicted from knowledge by radio of storm's position and probable path.

This typhoon was encountered by the American steamer *Wisconsin* on the 5th, highest wind force 9 from south-southwest, pressure 29.51, near 30° N., 135° E., and by the Japanese steamer *Ayaha Maru* on the 6th and 7th, wind east-northeast 8, barometer 29.10, near 40° N., 148° E.

According to the Tokyo weather maps another typhoon appeared northeast of Luzon on the 28th, and was central on the 30th near 26° N., 129′ E., apparently moving northward.

The tropical hurricane reported last month as existing southwest of the Gulf of Tehuantepec at the end of May, continued into the first day of June, when it appeared central off the coast of Mexico close to Acapulco. The southbound American steamer *Corinto* reported strong to whole west to west-southwest gales for a few hours near midday, lowest barometer 29.52, in 16° 22′ N., 99° 46′ W.

On the 16th and 17th another tropical cyclone appeared at sea southwest of Acapulco, but at a greater distance from it than its predecessor. At this writing the storm has been reported by only one vessel, the American steamer *Victorious*, which ran into the gale zone of the storm with an east wind of force 7 at 4 a. m. of the 16th, in 14° N., 103° 30′ W., and left t more than 24 hours later, with wind south-southeast, 7, in 13° 50′ N., 101° 23′ W. The highest wind experienced was force 10, from east by south, lowest barometer 29.66, at about 4 p. m. of the 16th. The cyclone can not be traced farther at this writing.

At Honolulu the prevailing wind was from the east, the trades blowing on all days of the month except the 18th, when there was a change to southerly. The maximum velocity was at the rate of 24 miles an hour from the east, on the 14th.

Fog showed a generally higher percentage of occurrence than in May over most of the northern half of the ocean, with the greatest frequency along the upper steamer routes between Japan and the one hundred and eightieth meridian, where the percentage averaged 40 or slightly more. East of the meridian the percentage lessened to about 20 south of the Gulf of Alaska, then increased to about 30 per cent along the central coast of California. once more decreasing to 25 per cent off Lower California. Two to four days with fog were reported along the lower routes between Japan and midocean, and the thirtieth and fortieth parallels, and 10 days with fog in the eastern part of the Bering Sea.

NOTES BY OBSERVERS

Fall of pumice.—American steamship *Grays Harbor*, Capt. F. P. Willarts, observer B. Fullington, second officer, Puget Sound to Yokohama:

On June 16, 9: 58 p. m., L. M. T., in latitude 42° 15′ N., longitude 149° 28′ E., vessel ran into a heavy fall of pumice, or volcanic ash. The sky was overcast, wind southwest, whole gale, lasted about two hours.

June 17, 9: 56 p. m., latitude 41° 43′ N., longitude 148° 50′ E., pumice began falling again much heavier, so thick that it was necessary to sound the fog signal. Pumice covered the vessel with a coating about 1-inch thick. Cleared up again in 41° 24′ N., 148° 24′ E., having fallen for about five hours. A radio report from Japan stated that Mount Homagatake erupted early on 18th, the discharge of smoke and ashes being violent. This mountain was about 360 miles from ship.

The American steamship *City of Victoria*, Capt. Gilbert Smith, was in the fall of pumice in the same vicinity on the 17th and 18th to the eastward of Tsugaru Straits. On the afternoon of the 17th it was reported that the pall of smoke and ash "put the ship in total darkness for two hours."

Phosphorescence.—Dutch steamship *Kertosono*, Capt. W. P. van Meerkerk, observer W. N. de Wijn, Manila to Los Angeles:

June 27. (G. M. N. latitude 36° 28′ N., longitude 125° 20′ W.) Passed from 8: 15 to 10 p. m. through a field of strong phosphorescence, light green colored and white on crest of sea. The whole scene was lighted as if it were daytime.

Trade winds.—British tanker *British Star*, Capt. T. S. Ridley, observer P. R. Harris, Chanaral, Chile, to San Pedro:

21st June, noon. Southeast trades encountered in latitude 20° S., longitude 75½° W. These trades were exceptionally strong, at one period reaching force 7, with heavy southeasterly sea and swell. On leaving Chanaral 19th, June, 8 p. m., a northeast gale was encountered with heavy continued rain. Wind veering abruptly from northwest to northeast, then back through west to southeast trades.

28th, June. Lost southeast trades in latitude 3½° N., 95½° W.

1st, July. Encountered northeast trades in latitude 10½° N., longitude 100° W.

3d, July. Lost northeast trades in latitude 19¾° N., longitude 108¼° W.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, June, 1929

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	77.1	−1.2	Thomasville	99	15	Riverton	46	4	5.23	+0.97	Spring Hill	17.00	Guntersville	1.63
Arizona	77.1	+0.1	Le Sage	125	24	Williams	22	1	0.08	−0.29	San Rafael	1.50	59 stations	0.00
Arkansas	76.2	−0.9	Thornburg	102	19	Thornburg	41	4	3.68	−0.34	Bentonville	8.05	Camden	0.02
California	66.5	−1.0	Greenland Ranch	124	23	Twin Lakes	7	1	1.37	+1.06	Lake Spaulding	5.82	18 stations	0.00
Colorado	61.8	+0.2	3 stations	105	[2] 15	Dillon	17	16	0.59	−0.98	Cope	2.98	15 stations	0.00
Florida	79.0	−0.8	do	100	21	Penney Farms	56	12	7.88	+1.26	Brooksville	13.69	New Smyrna	1.47
Georgia	76.4	−1.6	do	103	[2] 20	Clayton	44	5	5.27	+0.86	Glennville	11.31	Tallapoosa	0.30
Idaho	59.4	−1.4	Hazelton	102	28	Big Springs	18	19	1.63	+0.34	Bungalow ranger station.	5.89	Pine	2.25
Illinois	69.3	−2.6	Mount Carmel	98	30	Waukegan	32	9	4.82	+0.95	Du Quoin	10.08	Mascoutah	2.30
Indiana	68.8	−2.8	Hobart	98	20	Howe	34	3	4.38	+0.55	Mauzy	8.45	Leavenworth	2.10
Iowa	67.6	−1.7	Guthrie Center	99	30	9 stations	38	[2] 3	3.08	−1.42	Sioux City	8.47	Toledo	0.82
Kansas	72.1	−1.1	4 stations	104	29	Ulysses	41	2	3.99	+0.15	Blue Rapids	10.08	Johnson	0.49
Kentucky	71.7	−2.1	Bowling Green	97	30	Farmers	37	4	4.11	−0.14	Paducah	6.91	Irvington	1.56
Louisiana	79.7	−0.4	Lake Arthur	101	22	Tallulah	54	5	3.41	−1.40	Paradis	10.00	Dodson	0.24
Maryland-Delaware	70.4	−0.5	2 stations	98	19	Oakland, Md	31	4	4.83	+0.90	Mechanicsville, Md.	8.48	Clear Spring, Md	1.89
Michigan	61.0	−3.0	Centerville (near)	97	19	Sidnaw	21	2	3.10	+0.04	Sack Bay	5.28	Saginaw	1.57
Minnesota	63.0	−1.0	Beardsley	100	29	Meadowlands	23	2	2.02	−2.08	Zumbrota	6.25	Moorhead	0.30
Mississippi	78.4	−0.3	Aberdeen	102	1	2 stations	48	4	3.40	−0.91	Bay St. Louis	6.37	Natchez	0.53
Missouri	71.3	−1.9	Caruthersville	99	30	Goodland	39	4	5.77	+0.90	Maryville	11.42	Leeper	2.66
Montana	58.7	−0.9	Crow Agency	104	28	Conway's Ranch	21	4	2.14	−0.43	Glendive	5.99	Copper	0.14
Nebraska	67.6	−1.7	St. Paul	110	29	Gordon	29	20	3.31	−0.49	Albion	10.19	Kowanda	0.30
Nevada	63.5	−1.4	Logandale	113	25	Millett	20	2	0.73	+0.19	Lamoille	2.56	3 stations	0.00
New England	64.7	+1.0	4 stations	96	[2] 17	Keene, N. H	30	3	2.88	−0.44	Garfield, Vt	10.62	Hyannis, Mass	0.01
New Jersey	69.5	+1.3	Tuckerton	98	19	Layton	33	4	3.11	−0.57	Newton	5.41	Cape May City	1.41
New Mexico	68.8	+0.6	Deming	110	22	Selsor Ranch	18	13	0.46	−0.88	Lake Alice (near)	2.28	30 stations	0.00
New York	66.0	+1.1	Troy	99	18	Allegany State Park	26	7	3.45	−0.23	Hoffmeister	7.94	Rochester	0.76
North Carolina	72.3	−1.4	Chapel Hill	101	22	Banners Elk	30	4	6.02	+1.27	Greenville	12.60	Tryon	2.50
North Dakota	61.4	−1.4	6 stations	98	[2] 15	Hansboro	21	12	1.44	−2.06	Beach	7.99	Pembina	0.15
Ohio	67.1	−1.9	Fremont	97	[2] 19	Dover	28	4	4.01	+0.12	Greenville	8.91	Lake Milton	1.55
Oklahoma	77.1	0.0	Hollis	108	21	Boise City	42	13	3.44	−0.50	Pawhuska	9.66	Supply	0.35
Oregon	59.7	−0.7	3 stations	102	24	Fremont	11	2	2.15	+0.88	Cruzatte	5.52	Warmspring	0.20
Pennsylvania	67.8	−0.4	4 stations	98	[2] 19	Ridgway	28	3	3.56	−0.54	Pine Grove	6.77	Lloyd	1.10
South Carolina	74.8	−2.7	Garnett	100	20	3 stations	46	4	5.73	+0.88	Cheraw	11.68	Walhalla	2.46
South Dakota	65.0	−1.1	Gannvalley	105	29	Vale	30	20	2.09	−1.40	Harvey's Ranch	5.92	Ipswich	T.
Tennessee	73.9	−0.6	2 stations	98	[2] 29	Rugby	38	4	4.62	+0.24	Clinton	9.59	Memphis	1.60
Texas	80.9	+0.8	Fort Stockton	109	22	Muleshoe	46	13	1.49	−1.78	Danevang	5.39	4 stations	0.00
Utah	63.4	−1.5	St. George	110	25	Woodruff	19	3	0.71	+0.06	Lower Mill Creek	3.19	10 stations	0.00
Virginia	70.5	−1.1	Winchester	99	[2] 18	Burkes Garden	31	4	5.43	+0.85	Pedlar Dam	11.32	Woodstock	1.97
Washington	59.4	−1.2	Mottinger	101	24	2 stations	26	[2] 2	2.29	+0.71	Wynoochee Oxbow	7.68	White Swan	0.02
West Virginia	68.2	−1.2	Charleston	100	22	Pickens	28	4	3.50	−0.73	Bayard	8.92	Dam 25, Ohio River	1.56
Wisconsin	62.4	−2.1	2 stations	94	[2] 17	Long Lake	22	3	3.87	−0.07	Rhinelander	7.93	Plymouth	1.74
Wyoming	57.9	−1.3	Wheatland	101	[2] 28	Pinedale	16	3	1.08	−0.57	Yoder	3.68	Deaver	T.
Alaska [May]	42.1	+0.2	Akiak	78	6	Barrow	0	3	2.31	+0.20	Chignik	22.98	2 stations.	0.03
Hawaii	74.4	+1.2	Waialua Mill	92	30	Volcano Observatory	51	27	2.72	−2.09	Puu Kukui (upper)	14.00	10 stations	0.00
Porto Rico	77.6	−0.8	Canovanas	95	21	Caguas	60	11	4.83	−1.77	Rio Grande	11.13	Ensenada	0.25

[1] For description of tables and charts, see REVIEW, January, p. 36.
[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, June, 1929*

District and station	Elevation of instruments			Pressure			Temperature of the air												Precipitation			Wind										
	Barometer above sea level	Thermometer above ground	Anemometer above ground	Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Total	Departure from normal	Days with 0.01, or more	Total movement	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							64.6	+1.1										75	2.14	−0.8										5.4		
Eastport	76	67	85	29.82	29.90	−0.03	55.5	+0.4	85	17	64	40	7	47	30	51	48	80	1.55	−1.4	11	4,949	s.	28	se.	29	2	11	17	7.2	0.0	0.0
Greenville, Me.	1,070	6		28.75	29.83		60.0		86	12	70	38	2	50	42				3.24		17	4,410	se.	19		2	6	9	15		0.0	0.0
Portland, Me.	103	82	117	29.81	29.93	−.02	63.0	+0.5	91	18	71	41	3	55	27	57	53	72	2.08	−1.2	16	4,892	s.	26	s.	5	13	9	8	4.7	0.0	0.0
Concord	289	70	79	29.61	29.91	−.05	64.6	+1.7	92	18	77	37	3	52	46				1.72	−1.5	11	3,359	nw.	20	w.	7	13	12	5	4.5	0.0	0.0
Burlington	403	11	48	29.47	29.90	−.06	64.4	−1.3	87	12	74	40	2	54	33				5.55	+2.2	13	4,904	s.	25	s.	25	7	8	15	6.2	0.0	0.0
Northfield	876	12	60	28.99	29.92	−.04	62.0	+0.7	87	12	74	34	9	50	40	58	54	78	4.78	+1.6	14	3,759	s.	30	ne.	18	5	11	14	6.7	0.0	0.0
Boston	125	115	188	29.79	29.92	−.04	68.4	+1.9	94	18	78	45	3	59	36	60	54	65	2.30	−0.6	6	4,838	nw.	23	nw.	29	12	12	6	5.1	0.0	0.0
Nantucket	12	14	90	29.92	29.93	−.05	64.1	+3.1	87	18	72	46	3	57	26	59	56	83	0.41	−2.3	4	8,272	sw.	30	ne.	10	11	11	8	5.2	0.0	0.0
Block Island	26	11	46	29.89	29.92	−.05	63.8	+2.0	85	18	70	46	3	57	20	60	58	86	1.09	−1.5	7	8,375	sw.	32	w.	29	10	14	6	5.0	0.0	0.0
Providence	160	215	251	29.76	29.93	−.04	68.2	−0.1	94	18	78	43	3	58	34	60	55	66	0.96	−1.7	6	6,616	n.	35	nw.	29	13	12	5	4.4	0.0	0.0
Hartford	159	122		29.76	29.93	−.04	68.8	+1.7	92	18	79	43	3	59	36				1.50	−1.5	9		sw.				11	9	10	5.0	0.0	0.0
New Haven	106	74	153	29.83	29.94	−.03	68.2	+1.6	93	18	77	44	3	59	33	62	58	73	1.57	−1.5	8	4,903	s.	22	sw.	12	11	13	6	4.9	0.0	
Middle Atlantic States							70.3	+0.1										72	4.03	+0.4										5.1		
Albany	97	107	115	29.81	29.91	−.06	68.5	+0.5	93	18	78	42	3	59	32	62	58	71	2.65	−0.7	13	4,069	sw.	24	s.	5	16	9	5	3.6	0.0	0.0
Binghamton	871	10	84	29.03	29.94	−.03	66.5	+0.9	91	19	78	36	3	55	30				2.64	−0.8	8	3,095	nw.	19	sw.	28	9	12	9	5.2	0.0	0.0
New York	314	414	454	29.61	29.94	−.04	70.0	+1.2	93	18	78	44	3	62	25	61	56	67	2.30	−1.0	8	8,755	s.	51	nw.	19	4	19	7	6.0	0.0	0.0
Bellefonte	1,050	5	36	28.86	29.95		64.9		92	18	79	32	3	51	41	59	56	73	2.68		6		w.				8	13	9	5.5	0.0	0.0
Harrisburg	374	94	104	29.57	29.96	−.03	70.6	+0.3	94	19	81	44	3	60	32	61	56	66	5.74	+2.2	12	3,906	w.	33	nw.	21	9	15	6	4.9	0.0	0.0
Philadelphia	114	123	367	29.83	29.96	−.02	72.8	+1.4	95	19	82	48	3	64	25	64	60	68	2.74	−0.5	7	7,904	sw.	32	n.	1	10	11	9	5.1	0.0	0.0
Reading	325	81	98	29.61	29.95		71.2		95	19	82	45	3	61	33	62	57	64	3.65	+0.1	10	3,636	sw.	19	n.	20	11	12	7	5.2	0.0	0.0
Scranton	805	111	119	29.11	29.96	−.02	67.8	0.0	92	19	79	40	3	56	37	60	55	66	3.43	−0.2	10	3,961	sw.	25	w.	5	5	11	14	6.3	0.0	0.0
Atlantic City	52	37	172	29.90	29.95	−.03	68.3	+1.7	92	19	75	47	4	62	28	63	60	78	2.02	−1.0	10	9,939	s.	38	ne.	10	12	13	5	4.5	0.0	0.0
Cape May	17	13	49				68.8	+1.1	90	18	77	46	3	61	28	64	61	80	1.41		10		s.				11	9	10		0.0	0.0
Sandy Hook	22	10	55	29.92	29.94		69.6		92	18	77	48	3	62	25	63	60	77	2.34	−1.4	7	7,651	s.	37	w.	25	8	15	7	4.8	0.0	0.0
Trenton	190	159	183	29.74	29.94		70.8		94	19	81	45	3	60	32	62	58	68	3.53	+0.4	11	5,650	sw.	29	ne.	20	10	12	8	5.3	0.0	0.0
Baltimore	123	100	215	29.82	29.95	−.04	73.3	+0.6	95	18	83	48	3	64	28	64	59	64	4.82	+0.9	11	6,186	sw.	42	sw.	14	13	11	6	4.7	0.0	0.0
Washington	112	62	85	29.84	29.95	−.05	72.4	+0.2	93	14	82	46	4	62	34	64	60	69	7.41	+3.3	14	3,186	s.	29	sw.	14	10	12	8	5.0	0.0	0.0
Cape Henry	18	8	54	29.93	29.95		72.9		92	13	80	51	5	66	24	67	64	78	5.60	+1.6	12	7,138	sw.	39	nw.	8	10	9	11	5.6	0.0	0.0
Lynchburg	681	153	188	29.25	29.98	−.03	72.6	−2.0	94	21	84	44	4	62	32	65	62	75	5.00	+1.2	16	3,846	w.	25	n.	12	11	12	7	4.8	0.0	0.0
Norfolk	91	170	205	29.88	29.98	−.02	73.4	−1.0	91	20	81	55	5	66	27	66	63	76	3.35	−0.9	10	7,423	s.	38	sw.	25	8	11	11	5.7	0.0	0.0
Richmond	144	11	52	29.82	29.97	−.04	73.1	−1.0	91	13	83	47	4	63	32	66	63	76	3.02	−0.9	9	4,399	sw.	32	w.	25	13	8	9	4.5	0.0	0.0
Wytheville	2,304	49	55	27.66	29.97	−.04	66.4	−2.3	86	21	77	40	4	56	31	61	58	78	8.26	+4.1	14	2,773	w.	26	w.	28	8	13	9	5.3	0.0	0.0
South Atlantic States							75.1	−1.3										77	4.45	−0.2										5.6		
Asheville	2,253	70	84	27.69	29.98	−.03	68.3	−0.4	86	21	78	45	4	58	29	62	59	79	4.27	+0.3	17	3,352	se.	20	nw.	28	12	12	6	4.5	0.0	0.0
Charlotte	779	55	62	29.16	29.98	−.03	75.0	−0.5	93	13	85	51	4	65	28	66	63	71	5.88	+1.7	13	2,576	sw.	18	nw.	19	7	15	8	5.6	0.0	0.0
Greensboro	886	5	56	29.05	30.00		71.8		92	20	83	45	5	61	33	66	63	78	6.31		15	4,831	sw.	30	sw.	24	4	16	10	6.0	0.0	0.0
Hatteras	11	5	50	29.96	29.96	−.05	75.1	−0.5	86	29	80	57	3	70	17	71	68	79	4.04	−0.5	12	7,980	sw.	36	w.	27	12	10	8	4.7	0.0	0.0
Raleigh	376	103	110	29.58	29.97	−.04	73.8	−1.9	95	21	84	49	4	64	26	67	64	76	4.99	+0.6	12	3,930	sw.	28	nw.	18	6	13	11	6.1	0.0	0.0
Wilmington	78	81	91	29.92	30.00	−.01	75.0	−1.8	91	20	84	52	4	67	25	69	67	81	2.87	−2.2	10	4,008	sw.	17	sw.	2	9	12	9	5.4	0.0	0.0
Charleston	48	11	92	29.95	30.00	−.01	76.6	−2.3	94	29	84	58	4	70	25	71	68	77	4.81	+0.2	11	5,672	s.	36	nw.	28	6	13	11	5.9	0.0	0.0
Columbia, S. C.	351	41	57	29.62	29.99	−.02	76.2	−1.9	95	29	86	52	4	66	28	68	66	77	4.24	+0.1	13	3,963	s.	25	sw.	26	13	9	8	4.7	0.0	0.0
Due West	711	10	55	29.26	30.02		74.6		95	21	85	51	4	65	26				5.20		13	4,818	sw.	26	ne.	3	5	12	13	6.2	0.0	0.0
Greenville, S. C.	1,039	139	146	28.91	29.98		74.3	+0.2	92	20	84	54	3	65	25	66	63	73	2.97	−1.6	12	5,128	ne.	29	ne.	3	6	16	8	5.5	0.0	0.0
Augusta	182	62	77	29.79	29.98	−.03	77.2	−1.5	96	21	87	53	4	67	27	70	66	74	5.89	+1.2	13	2,708	s.	22	w.	8	6	9	13	5.8	0.0	0.0
Savannah	65	150	194	29.93	30.00	−.01	77.3	−1.7	94	20	84	58	4	69	25	71	69	81	4.88	−0.4	13	5,857	se.	36	nw.	28	10	7	13	5.9	0.0	0.0
Jacksonville	43	209	245	29.94	29.99	−.02	77.6	−2.3	92	28	85	61	11	70	20	71	69	80	4.10	−1.2	16	5,755	s.	41	nw.	2	4	15	11	6.3	0.0	0.0
Florida Peninsula							80.4	−0.3										79	5.31	−0.8										5.8		
Key West	22	10	64	29.94	29.96	−.03	81.8	−0.1	89	11	86	71	2	77	14	75	73	78	3.08	−1.2	10	6,289	se.	30	sw.	12	8	13	9	5.3	0.0	0.0
Miami	25	141	168	29.97	30.00	−.01	79.4	−0.6	90	30	85	68	11	74	20	74	72	79	5.61	−1.2	22	5,689	se.	38	s.	1	1	16	13	7.3	0.0	0.0
Tampa	35	79	87	29.95	29.98	−.03	80.1	−0.1	92	29	88	67	11	72	23	73	71	79	7.25	0.0	16	3,387	e.	25	se.	17	4	8	18	6.7	0.0	0.0
Titusville	44	5		29.94	29.99		78.4		94	30	87	63	11	70	26				2.52		10		se.				15	15	0	3.8	0.0	0.0
East Gulf States							77.6	−0.9										76	5.81	+1.2										5.4		
Atlanta	1,173	190	216	28.78	29.99	−.02	75.0	−1.0	92	21	84	55	4	66	24	66	63	72	3.68	−0.1	14	4,948	s.	26	sw.	24	5	14	11	6.3	0.0	0.0
Macon	370	78	87	29.60	29.99	−.02	76.7	−2.2	96	21	87	54	5	67	26	69	66	75	8.54	+4.5	10	3,152	s.	22	ne.	21	8	12	10	5.7	0.0	0.0
Thomasville	273	49	58	29.70	29.99	−.01	77.6	−1.9	96	21	87	58	5	68	28	70	68	78	6.66	+1.2	16	2,228	e.	16	nw.	21	4	14	12	6.8	0.0	0.0
Apalachicola	36	42	49	29.94	29.98		78.4		94	30	84	66	4	72	18	74	71	79	6.69	+1.1	12	4,571	s.	28	n.	4	11	12	7	5.1	0.0	0.0
Pensacola	56	149	185	29.91	29.97	−.02	78.4	−0.9	90	30	84	67	5	73	18	73	71	80	7.51	+2.8	13	7,747	s.	54	s.	25	6	17	7	5.6	0.0	0.0
Anniston	741	9	57	29.22	30.00		75.0	0.0	95	20	86	53	5	64	30				3.96	−0.2	12	2,305	s.	14	nw.	2	11	13	6	4.6	0.0	0.0
Birmingham	700	11	48	29.24	29.99	.00	76.5	−1.4	95	30	86	57	4	67	25	68	65	75	4.88	+0.4	12	3,347	s.	20	nw.	24	3	17	8	5.8	0.0	0.0
Mobile	57	125	161	29.90	29.98	−.03	79.6	−0.7	97	21	88	64	5	72	23	72	70	78	11.83	+5.4	12	5,574	s.	34	sw.	24	3	17	10	5.8	0.0	0.0
Montgomery	223	100	112	29.74	29.98	−.02	78.4	−1.2	97	21	87	61	5	70	28	70	66	71	4.68	+0.9	12	3,722	s.	31	n.	2	9	14	7	5.1	0.0	0.0
Corinth	469	6					78.3		98	1	90	51	4	66	34				3.66		8		s.				4	26	0		0.0	0.0
Meridian	375	87	95	29.57	29.96	−.02	77.0	−1.1	93	20	86	58	4	67	27	70	67	74	5.88	+1.3	10	3,027	sw.	22	nw.	7	10	15	5	4.7	0.0	0.0
Vicksburg	247	65	73	29.70	29.98	+.01	78.2	−0.8	93	1	87	60	4	70	24	71	68	74	2.40	−1.6	12	3,301	se.	20	e.	14	13	10	7	4.3	0.0	0.0
New Orleans	53	76	84	29.90	29.95	−.03	81.4	+0.8	96	21	89	69	14	74	20	74	72	74	3.00	−2.9	13	3,281	se.	20	nw.	14	6	18	6	5.7	0.0	0.0
West Gulf States							79.9	0.0										73	1.87	−1.4										3.5		
Shreveport	249	77	93	29.68	29.94	−.02	80.4	−0.3	97	22	90	59	4	70	27	72	69	72	0.88	−2.6	4	3,598	s.	24	ne.	22	18	11	1	2.8	0.0	0.0
Bentonville	1,303	11	44	28.60	29.94	.00	72.5	−1.6	90	11	82	50	4	63	28				8.05		14	3,028	s.	20	w.	3	27	2	1		0.0	0.0
Fort Smith	457	79	94	29.45	29.92	−.02	76.7	−0.8	96	11	86	57	4	67	26	69	66	70	5.22	+1.5	10	4,517	e.	36	n.	22	15	9	6	4.4	0.0	0.0
Little Rock	357	136	153	29.58	29.94	−.02	77.0	−0.4	94	30	86	54	4	68	23	68	64	68	4.25	+0.5	10	4,910	s.	42	nw.	24	10	13	7	4.9	0.0	0.0
Austin	605	136	148	29.28	29.91		81.8	−0.6	97	14	92	67	27	72	24	72	68	70	0.97	−1.5	4	4,830	s.	28	ne.	24	14	14	2	3.6	0.0	0.0
Brownsville	57	83	100	29.83	29.89		81.8	−0.6	93	10	89	71	28	74	19	74	72	79	1.54	−1.3	6	6,220	se.	24	se.	29	20	8	2	3.0	0.0	0.0
Corpus Christi	20	11	78	29.89	29.91	.00	81.8	−0.8	94	25	88	72	28	76	14	76	74	79	1.59	−1.0	3	7,307	e.	36	ne.	28	18	9	3	3.5	0.0	0.0
Dallas	512	220	227	29.38	29.92		81.0		95	21	91	63	4	72	21				0.33	−3.6	3	7,417	se.	34	ne.	3	21	8	1	2.2	0.0	0.0
Fort Worth	670	106	114	29.19	29.89	−.03	81.8	+1.9	100	22	92	64	4	71	27	70	65	63	0.20	−3.2	3	6,523	se.	25	s.	12	17	10	3	3.4	0.0	0.0
Galveston	54	106	114	29.89	29.95	.00	81.6	+0.9	94	9	86	65	14	77	21	75	72	77	1.96	−2.4	4	6,561	s.	31	se.	28	18	10	2	3.3	0.0	0.0
Groesbeck	461	11	56	29.44	29.91		80.0		94	21	90	64	15	70	25				0.37	−2.4	3	6,033	se.	32	ne.	28	14	16	0	3.5	0.0	0.0
Houston	138	292	314	29.80	29.94		81.0	−0.4	96	22	90	64	14	72	25				3.20	−1.4	10	6,671	se.	37	n.	14	18	7	5	3.9	0.0	0.0
Palestine	510	64	72	29.42	29.93	−.01	79.6	+0.6	95	21	89	63	4	70	26	72	69	74	2.88	−0.8	3	4,118	s.	32	sw.	24	15	11	4	3.8	0.0	0.0
Port Arthur	34	58	66	29.90	29.94		81.6		95	21	88	69	14	75	21	76	74	82	3.33		6	4,476	s.	18	e.	10	21	7	2	2.9	0.0	0.0
San Antonio	693	119	132	29.19	29.91	.00	81.7	+0.7	96	27	91	70	27	72	26	72	69	70	2.19	−0.3	4	4,658	se.	42	nw.	28	12	17	1	3.7	0.0	0.0
Taylor	583	55	63	29.34	29.95	+.03	81.0	+1.0	96	10	91	65	15	71	27				0.62	−1.4	5	5,068	s.	29	e.	14	13	16	1	3.4	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, June, 1929*—Continued

District and station	Elevation of instruments			Pressure			Temperature of the air												Precipitation			Wind										
	Barometer above sea level	Thermometer above ground	Anemometer above ground	Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Total	Departure from normal	Days with 0.01, or more	Total movement	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	° F.	° F.	° F.		° F.	° F.		° F.	° F.	° F.	° F.	%	In.	In.		Miles								0-10	In.	In.
Ohio Valley and Tennessee							71.1	−1.6										69	3.98	+0.1										4.9		
Chattanooga	762	190	215	29.17	29.96	−0.04	74.4	−1.0	91	21	84	56	4	65	27	66	62	70	4.39	+0.2	12	4,022	sw.	30	nw.	13	8	14	8	5.0	0.0	0.0
Knoxville	995	102	111	28.94	29.98	−.02	73.4	−0.6	92	22	83	50	4	64	29	65	61	70	6.29	+2.2	13	3,777	sw.	23	n.	12	9	13	8	5.6	0.0	0.0
Memphis	399	76	97	29.54	29.95	−.02	77.4	−0.2	92	30	85	55	4	70	20	68	64	66	1.60	−2.0	4	4,351	sw.	36	n.	7	10	17	3	4.7	0.0	0.0
Nashville	546	168	191	29.42	29.99	.00	74.3	−1.3	94	30	85	52	4	64	29	66	62	68	2.02	−2.0	10	4,626	ne.	38	nw.	12	11	15	4	4.1	0.0	0.0
Lexington	989	193	230	28.95	30.00	.00	70.6	−1.6	90	22	80	42	3	61	28				4.25	+0.2	12	6,903	sw.	36	ne.	30	11	16	3	4.4	0.0	0.0
Louisville	525	188	234	29.41	29.99	+.01	72.2	−2.5	92	30	82	44	3	62	28	64	60	70	4.46	+0.6	12	5,652	s.	40	sw.	24	13	13	4	4.2	0.0	0.0
Evansville	431	76	116	29.53	29.99	+.02	73.8	−1.3	95	30	84	47	3	64	25	65	61	68	3.50	−0.5	7	5,020	s.	38	n.	12	11	14	5	4.5	0.0	0.0
Indianapolis	822	194	230	29.10	29.98	+.01	69.6	−2.0	90	18	79	40	3	60	27	61	56	65	5.36	+1.7	12	6,465	sw.	64	nw.	30	14	12	4	4.4	0.0	0.0
Royal Center	736	11	55	29.18	29.98		66.2		88	18	77	38	3	56	31				2.98	−0.6	11	5,415	s.	37	nw.	11	7	14	9	5.4	0.0	0.0
Terre Haute	575	96	129	29.35	29.96		70.8		92	30	81	43	3	61	28	63	58	68	3.61	−0.3	7	5,380	s.	24	w.	28	9	17	4	5.0	0.0	0.0
Cincinnati	627	11	51	29.32	29.99	.00	69.4	−1.8	90	24	80	40	3	59	29	62	58	71	4.98	+1.3	12	3,752	sw.	23	ne.	16	10	12	8	4.7	0.0	0.0
Columbus	822	179	222	29.13	29.99	.00	68.7	−2.2	92	18	78	41	3	59	30	62	57	70	4.76	+1.4	13	5,328	s.	40	nw.	28	13	10	7	4.5	0.0	0.0
Dayton	899	137	173	29.04	29.97		68.9	−2.5	90	18	79	40	3	58	29	61	56	68	5.30	+1.5	13	5,053	sw.	31	nw.	30	8	16	6	5.2	0.0	0.0
Elkins	1,947	59	67	27.99	29.99	−.01	64.5	−2.4	88	22	77	34	4	52	37	59	56	77	4.62	−0.4	11	2,648	w.	30	n.	22	7	14	9	6.1	0.0	0.0
Parkersburg	637	77	82	29.35	30.00	.00	69.9	−1.5	91	19	81	44	3	59	32	61	56	66	3.31	−0.7	10	2,981	se.	20	sw.	7	12	8	10	5.5	0.0	0.0
Pittsburgh	842	353	410	29.08	29.97	−.02	68.7	−2.0	92	18	78	40	3	59	32	60	54	63	2.21	−1.6	9	5,671	sw.	31	sw.	14	6	15	9	5.5	0.0	0.0
Lower Lake Region							65.4	−1.4										69	2.52	−0.8										4.9		
Buffalo	767	247	280	29.12	29.95	−.02	63.6	−0.8	88	24	71	39	2	56	23	57	53	72	1.66	−1.2	11	8,782	sw.	46	sw.	30	10	14	6	4.7	0.0	0.0
Canton	448	10	61	29.43	29.90		63.2	−2.6	88	18	74	39	3	53	32				4.50	+1.2	16	5,104	w.	45	sw.	23	12	9	9	4.8	0.0	0.0
Ithaca	836	5	100	29.05	29.94		63.8		89	18	75	32	3	53	37	58	55	73	2.42	−1.1	9	4,467	nw.	28	w.	19	10	8	12	5.5	0.0	0.0
Oswego	335	76	91	29.57	29.93	−.04	63.0	−1.8	85	23	71	39	6	55	29	57	53	70	2.08	−1.2	8	4,636	w.	20	n.	1	11	9	10	4.8	0.0	0.0
Rochester	523	86	102	29.39	29.95	−.02	65.8	−0.3	92	18	75	40	6	56	32	58	52	64	0.76	−2.2	8	5,050	w.	28	sw.	28	10	13	7	4.7	0.0	0.0
Syracuse	596	65	79	29.31	29.94	−.03	66.8	−0.1	90	12	76	41	6	58	30				1.33	−2.5	8	4,065	s.	20	nw.	29	11	13	6	5.1	0.0	0.0
Erie	714	130	166	29.20	29.96	−.02	65.3	−0.9	87	18	74	42	2	57	30	59	54	66	1.38	−2.0	10	6,850	sw.	40	sw.	14	14	12	4	3.7	0.0	0.0
Cleveland	762	190	201	29.16	29.97	−.01	65.8	−1.3	87	18	74	44	2	58	30	58	53	65	4.17	+1.0	10	6,931	s.	42	s.	30	9	13	8	5.3	0.0	0.0
Sandusky	629	5	67	29.30	29.98	.00	67.1	−1.7	91	18	77	44	4	58	34				4.12	+0.6	9	4,968	sw.	26	nw.	16	8	14	8	5.3	0.0	0.0
Toledo	628	208	243	29.30	29.98	+.01	66.4	−2.3	90	18	76	38	3	57	27	59	55	68	3.03	−0.3	9	7,612	sw.	49	w.	28	15	10	5	4.2	0.0	0.0
Fort Wayne	856	113	124	29.05	29.97		66.8	−1.7	89	18	77	38	3	57	31	60	55	68	2.30	−1.3	10	5,150	sw.	31	nw.	11	4	16	10	6.1	0.0	0.0
Detroit	730	218	258	29.19	29.98	+.01	65.8	−1.6	90	18	75	40	2	56	27	60	57	76	2.55	−1.0	10	5,772	sw.	28	sw.	11	13	14	3	4.3	0.0	0.0
Upper Lake Region							60.2	−2.4										72	3.04	−0.2										5.1		
Alpena	609	13	92	29.29	29.96	.00	58.4	−2.0	91	18	67	38	7	50	29	54	50	75	3.96	+0.7	14	6,069	nw.	34	sw.	11	10	13	7	4.9	0.0	0.0
Escanaba	612	54	60	29.29	29.95	+.01	56.5	−4.2	77	30	64	35	5	49	26	52	48	76	3.79	+0.6	12	6,691	s.	31	n.	11	13	10	7	4.7	0.0	0.0
Grand Haven	632	54	89	29.28	29.95	−.01	61.2	−2.5	85	17	69	41	3	53	27	56	51	71	2.65	−0.3	13	6,228	w.	38	w.	27	13	9	8	5.1	0.0	0.0
Grand Rapids	707	70	87	29.21	29.97	.00	64.8	−3.0	90	18	75	40	3	55	32	57	51	64	2.18	−1.3	11	3,255	w.	27	nw.	11	6	14	10	5.9	0.0	0.0
Houghton	668	64	99	29.22	29.94	.00	57.7	−2.3	90	17	69	33	5	47	40				1.64	−1.2	12	5,094	e.	30	w.	20	6	17	7	5.5	0.0	0.0
Lansing	878	6	49	29.03	29.97		62.4	−4.0	88	18	74	35	3	51	36	58	55	78	2.17	−1.3	10	2,779	sw.	22	nw.	11	9	13	8	5.3	0.0	0.0
Ludington	637	60	66	29.26	29.96		58.0		83	17	65	37	3	50	26	54	51	78	2.69	−0.2	10	5,942	s.	24	s.	27	15	10	5	4.2	0.0	0.0
Marquette	734	77	111	29.15	29.95	+.01	56.6	−2.3	88	18	65	34	5	48	40	51	46	68	3.73	+0.5	12	5,532	n.	27	w.	16	5	10	15	6.3	0.0	0.0
Port Huron	638	70	120	29.28	29.97	.00	62.0	−2.0	88	18	71	39	3	53	32	57	53	74	1.84	−0.9	12	6,494	sw.	28	nw.	28	13	14	3	4.0	0.0	0.0
Sault Sainte Marie	614	11	52	29.26	29.96	.00	57.1	−1.5	88	17	67	36	2	47	31	51	47	74	3.05	+0.1	12	4,441	nw.	23	nw.	20	15	11	4	4.4	0.0	0.0
Chicago	673	7	131	29.25	29.97	+.01	64.4	−2.9	90	18	72	45	4	57	30	57	53	71	4.96	+1.7	9	6,327	ne.	37	se.	11	9	8	13	5.9	0.0	0.0
Green Bay	617	109	141	29.28	29.94	−.01	61.8	−3.1	86	18	71	39	3	53	32	56	53	75	3.75	0.0	13	7,105	s.	29	s.	10	6	15	9	6.1	0.0	0.0
Milwaukee	681	125	221	29.23	29.96	+.01	62.2	−1.7	88	18	72	42	3	53	34	55	49	66	3.42	0.0	11	8,385	n.	37	w.	11	13	8	9	4.9	0.0	0.0
Duluth	1,133	5	47	28.72	29.94	+.02	57.4	+0.2	86	10	69	33	3	46	39	51	46	70	2.77	−1.1	12	6,835	ne.	29	ne.	12	8	18	4	4.3	0.0	0.0
North Dakota							62.3	−0.9										60	1.77	−2.0										4.6		
Moorhead	940	50	58	28.88	29.89	−.01	64.0	−0.4	95	16	77	39	3	51	37	54	46	56	0.30	−3.8	8	5,230	s.	24	se.	17	8	12	10	5.3	0.0	0.0
Bismarck	1,674	8	57	28.12	29.88	+.01	62.9	−0.8	90	30	76	36	12	50	35	54	46	59	1.09	−2.3	8	6,178	nw.	33	nw.	27	15	10	5	4.1	0.0	0.0
Devils Lake	1,478	11	44	28.33	29.89	+.01	60.7	−1.2	90	16	73	35	12	48	34	53	46	64	5.26	+1.7	11	5,761	w.	28	se.	8	13	12	5	4.3	0.0	0.0
Ellendale	1,457	10	56	28.36	29.90		62.9		93	9	76	36	4	49	40				0.47	−4.1	9	8,510	nw.	39	nw.	11	8	14	8	5.2	0.0	0.0
Grand Forks	833	12	67				62.6		93	16	76	37	12	50	39	55			1.56		14		nw.		se.	17	16	13	1		0.0	0.0
Williston	1,878	41	48	27.91	29.86	.00	61.6	−1.1	90	16	73	39	25	50	43	53	47	62	1.72	−1.7	11	5,786	se.	38	nw.	9	14	10	6	4.0	0.0	0.0
Upper Mississippi Valley							68.2	−2.2										68	3.83	−0.3										5.3		
Minneapolis	918	102	208	28.92	29.88		65.6	−1.9	92	10	76	42	2	56	30				4.21	0.0	10	6,840	s.	36	w.	27	8	11	11	5.8	0.0	0.0
St. Paul	837	236	261	29.02	29.92	.00	64.4	−2.7	89	10	75	42	2	54	29				4.66	+0.5	10	7,181	sw.	44	w.	10	9	13	8	5.3	0.0	0.0
La Crosse	714	11	48	29.17	29.93	.00	65.6	−2.7	89	10	76	42	3	55	31	59	54	73	3.63	−0.4	11	2,556	s.	18	ne.	11	10	10	10	5.4	0.0	0.0
Madison	974	70	78	28.93	29.96	+.02	63.8	−3.4	86	30	72	39	3	55	29	57	52	67	4.35	+0.6	11	4,899	ne.	23	ne.	2	9	10	11	5.4	0.0	0.0
Wausau	1,247	4	64	28.62	29.94		63.0		86	17	74	37	3	52	34				3.71	−0.3	11	3,520	s.	21	w.	11	8	12	10	5.4	0.0	0.0
Charles City	1,015	10	51	28.88	29.94	+.03	65.6	−0.9	89	10	77	41	3	54	36	59	53	66	1.49	−3.1	8	3,777	se.	26	se.	16	11	12	7	4.8	0.0	0.0
Davenport	606	71	79	29.28	29.94	.00	69.0	−1.5	89	19	79	42	3	59	28	60	55	65	4.30	+0.2	11	5,907	ne.	35	nw.	11	8	11	11	5.7	0.0	0.0
Des Moines	861	84	97	29.03	29.92	.00	69.0	−1.6	94	30	79	43	3	58	33	61	56	65	2.42	−2.3	10	4,686	s.	23	sw.	29	9	12	9	5.5	0.0	0.0
Dubuque	700	81	96	29.20	29.94	+.01	66.4	−3.0	87	30	76	43	3	57	27	59	53	64	4.69	+0.4	8	3,702	s.	24	nw.	27	8	11	11	6.3	0.0	0.0
Keokuk	614	64	78	29.29	29.95	+.01	70.0	−2.5	94	30	80	43	3	60	28	62	58	67	3.91	−0.2	11	4,472	s.	20	s.	17	9	7	14	5.9	0.0	0.0
Cairo	358	87	93	29.59	29.96	−.01	74.4	−1.9	94	30	83	53	3	66	24	67	63	71	3.76	−0.1	7	4,928	s.	38	nw.	12	8	10	12	5.6	0.0	0.0
Peoria	609	11	45	29.31	29.97	+.02	68.6	−2.3	93	30	80	41	4	58	31	62	57	70	4.44	+0.7	10	3,685	s.	28	n.	30	10	11	9	5.0	0.0	0.0
Springfield, Ill.	636	154	191	29.29	29.96	+.01	69.3	−2.9	93	30	79	41	3	60	27	65	62	77	3.41	−0.6	8	7,153	s.	38	n.	11	13	9	8	4.8	0.0	0.0
Hannibal	534	74	109	29.37	29.93	−.02	70.6	−1.9	93	30	80	46	4	61	27				4.80	+0.9	11	5,227	s.	37	sw.	20	13	7	10	4.8	0.0	0.0
St. Louis	568	265	303	29.36	29.95	.00	72.8	−2.0	93	30	82	47	3	64	26	65	60	67	3.65	−0.2	10	6,992	s.	32	sw.	11	15	7	8	4.4	0.0	0.0
Missouri Valley							69.5	−1.3										66	4.39	+0.1										4.7		
Columbia, Mo.	784	6	84	29.11	29.93	−.02	71.2	−1.6	92	30	80	48	3	62	27				7.49	+2.7	14	4,214	s.	27	nw.	20	11	10	9	4.9	0.0	0.0
Kansas City	963	161	181	28.91	29.92	.00	72.4	−1.2	93	30	81	47	2	64	23	64	60	68	8.09	+3.1	11	5,943	s.	39	nw.	20	13	11	6	4.5	0.0	0.0
St. Joseph	967	11	49	28.90	29.91		71.4		95	15	81	46	2	62	30	64	60	70	6.71	+1.8	12	5,000	se.	35	nw.	19	17	8	5	4.1	0.0	0.0
Springfield, Mo.	1,324	98	104	28.58	29.96	+.01	71.0	−1.5	89	11	80	48	4	62	25	65	61	74	4.78	+0.1	11	5,729	s.	28	w.	1	20	7	3	2.8	0.0	0.0
Iola	984	11	50	28.89	29.91	−.02	72.4	−1.7	93	30	82	50	4	63	30				4.07	−1.4	9	3,705	s.	33	nw.	18	15	10	5	4.3	0.0	0.0
Topeka	987	92	107				72.4	−1.0	95	15	82	50	4	63	29				3.18	−1.5	9	6,038	sw.	37	e.	2	15	10	5	4.1	0.0	0.0
Lincoln	1,189	11	81	28.66	29.89	−.01	70.4	−1.0	97	30	81	48	3	60	35	62	57	66	1.86	−2.5	9	6,092	s.	28	w.	19	8	13	9	5.2	0.0	0.0
Omaha	1,105	115	122	28.75	29.91	.00	70.6	−1.0	97	30	80	47	3	61	30	61	55	62	2.94	−1.6	14	4,734	s.	26	n.	11	11	11	8	4.9	0.0	0.0
Valentine	2,598	47	54	27.24	29.91	+.05	65.3	−1.9	102	29	78	42	13	53	42	56	50	64	3.69	+0.8	13	5,478	e.	31	nw.	19	11	11	8	5.0	0.0	0.0
Sioux City	1,135	94	164	28.72	29.91	+.01	67.6	−1.9	96	29	77	46	3	58	33	60	55	67	8.47	+4.5	18	6,966	s.	47	nw.	11	7	12	11	6.1	0.0	0.0
Huron	1,306	59	74	28.54	29.92	+.04	66.6	+0.4	101	29	78	45	13	55	41	57	49	60	0.89	−2.9	7	5,858	s.	40	n.	11	12	11	7	4.8	0.0	0.0
Pierre	1,572	70	75				67.4	−1.1	100	29	79	46	24	56	38				1.83	−1.1	8						9	11	10		0.0	0.0
Yankton	1,233	49	57	28.60	29.90	+.01	67.2	−1.7	100	29	77	46	13	57	37				3.11	−0.7	14	4,455	s.	34	nw.	11	9	10	11	5.7	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, June, 1929*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation: Thermometer above ground	Elevation: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	° F.	° F.	° F.		° F.	° F.		° F.	° F.	° F.	° F.	%	In.	In.		Miles								0-10	In.	In.
Northern Slope							**61.0**	**−0.5**										**58**	**1.55**	**−0.8**										**4.9**		
Billings	3,140	5	----	----	----	----	63.4	----	98	28	81	34	20	46	49	----	----	----	1.06	----	8	----	nw.	----	----	----	9	15	6	----	0.0	0.0
Havre	2,505	11	44	27.26	29.86	+0.01	62.0	0.0	92	28	75	41	5	49	38	52	44	57	2.50	−0.4	8	4,984	sw.	26	w.	19	9	16	5	4.9	0.0	0.0
Helena	4,110	87	112	25.75	29.88	.00	59.4	+0.2	92	28	72	35	4	47	39	48	40	55	0.99	−1.4	11	5,898	sw.	33	sw.	17	7	11	12	6.2	0.0	0.0
Kalispell	2,973	48	56	26.86	29.88	−.01	57.4	−0.3	84	28	69	35	20	46	36	48	40	61	0.95	−1.1	11	4,219	se.	40	sw.	8	11	12	7	5.0	0.0	0.0
Miles City	2,371	48	55	27.39	29.90	+.05	64.4	−1.6	96	28	76	42	4	52	42	54	47	61	2.94	+0.3	9	3,243	s.	33	w.	9	15	12	3	4.1	0.0	0.0
Rapid City	3,259	50	58	26.57	29.93	+.08	62.8	−1.4	93	29	74	42	24	52	36	54	47	59	3.83	+0.5	13	4,712	w.	28	n.	19	10	11	9	5.3	0.0	0.0
Cheyenne	6,088	84	101	24.02	29.87	+.03	60.4	0.0	91	29	74	34	3	47	38	48	39	53	0.72	−0.9	7	7,726	s.	45	w.	17	12	10	8	5.0	0.0	0.0
Lander	5,372	60	68	24.62	29.87	+.02	60.3	−0.2	93	29	76	30	3	45	42	48	38	48	0.13	−1.0	5	4,092	w.	37	w.	9	18	10	2	3.2	0.0	0.0
Sheridan	3,790	10	47	26.05	29.89	----	60.0	----	91	28	75	33	20	45	45	51	44	61	0.95	−1.1	10	2,946	nw.	24	se.	1	12	17	1	4.5	0.0	0.0
Yellowstone Park	6,241	11	48	23.89	29.92	+.06	53.4	−2.6	84	28	66	30	3	40	37	43	36	60	1.26	−0.7	14	5,356	sw.	48	sw.	15	4	11	15	6.3	0.2	0.0
North Platte	2,821	11	51	27.02	29.89	+.03	68.6	+1.1	103	29	81	43	20	56	41	58	51	63	1.24	−2.0	10	4,099	se.	20	nw.	17	15	8	7	4.4	0.0	0.0
Middle Slope							**72.4**	**+0.5**										**61**	**3.19**	**0.0**										**4.5**		
Denver	5,292	106	113	24.72	29.86	+.02	67.2	+0.9	95	29	81	45	7	54	38	52	40	45	0.67	−0.7	6	4,974	s.	30	nw.	15	11	11	8	4.7	0.0	0.0
Pueblo	4,685	80	86	25.23	29.80	−.03	71.0	+2.0	98	29	87	45	13	55	45	53	38	41	0.15	−1.2	2	4,881	se.	30	w.	15	13	14	3	4.4	0.0	0.0
Concordia	1,392	50	58	28.47	29.92	+.02	71.4	−1.6	95	15	81	48	3	61	31	64	60	70	4.12	−0.3	11	4,833	s.	29	n.	22	10	9	11	5.4	0.0	0.0
Dodge City	2,509	11	51	27.36	29.90	+.03	72.7	+0.2	99	10	85	50	3	61	39	62	57	64	2.73	−0.6	8	6,602	se.	28	s.	16	19	6	5	3.4	0.0	0.0
Wichita	1,358	139	158	28.48	29.88	−.03	73.7	−0.7	94	11	83	52	3	64	30	66	63	73	7.13	+2.8	10	7,873	s.	44	n.	2	14	11	5	4.6	0.0	0.0
Broken Arrow	765	11	56	29.12	29.93	----	74.2	----	92	11	82	59	3	66	28	----	----	----	5.95	+1.8	12	8,128	s.	34	sw.	12	10	12	8	5.5	0.0	0.0
Oklahoma City	1,214	10	47	28.64	29.89	−.02	78.1	+2.1	98	11	88	59	13	68	31	69	66	73	1.60	−2.1	7	6,627	s.	26	s.	17	19	9	2	3.3	0.0	0.0
Southern Slope							**79.4**	**+1.5**										**54**	**1.34**	**−1.2**										**2.9**		
Abilene	1,738	10	52	28.11	29.86	−.02	82.4	+3.2	103	22	94	64	14	71	32	68	60	54	0.13	−2.9	2	7,376	s.	29	s.	16	18	10	2	2.9	0.0	0.0
Amarillo	3,676	10	49	26.24	29.87	+.02	75.1	+2.3	102	28	88	53	3	62	35	61	54	56	0.77	−2.1	9	6,407	s.	24	se.	5	19	7	4	3.3	0.0	0.0
Del Rio	944	64	71	28.87	29.82	−.03	84.0	+0.6	99	11	95	65	25	73	32	71	65	60	3.32	+0.8	3	7,314	se.	34	sw.	3	18	12	0	2.8	0.0	0.0
Roswell	3,566	75	85	26.30	29.82	+.02	76.2	−0.1	101	27	91	55	1	61	37	59	46	45	1.15	−0.5	5	4,792	s.	29	s.	9	21	8	1	2.5	0.0	0.0
Southern Plateau							**75.6**	**+1.4**										**28**	**0.12**	**−0.2**										**1.8**		
El Paso	3,778	152	175	26.10	29.75	.00	83.5	+3.9	105	27	97	60	29	70	37	57	33	21	0.54	0.0	1	6,689	e.	46	ne.	29	25	5	0	1.6	0.0	0.0
Santa Fe	7,013	38	53	23.30	29.78	−.03	66.2	+1.4	91	27	80	43	3	53	39	48	32	32	0.04	−1.0	1	4,093	sw.	22	ne.	28	15	13	2	3.5	0.0	0.0
Flagstaff	6,907	10	59	23.38	29.80	+.02	60.0	+0.7	92	23	79	27	2	41	52	42	----	31	T.	----	0	----	sw.	----	s.	9	18	9	3	----	0.0	0.0
Phoenix	1,108	10	107	28.61	29.72	−.02	86.4	+1.9	118	24	104	55	2	69	45	58	34	20	T.	−0.1	0	4,060	w.	26	s.	29	23	6	1	1.3	0.0	0.0
Yuma	141	9	54	29.60	29.74	.00	84.5	−0.2	117	24	102	57	2	67	48	63	46	35	0.00	0.0	0	3,072	sw.	20	se.	26	27	3	0	0.8	0.0	0.0
Independence	3,957	6	27	25.90	29.86	+.08	72.9	+0.6	103	21	89	41	17	57	41	50	----	----	0.02	−0.1	1	----	nw.	----	----	----	18	7	5	----	0.0	0.0
Middle Plateau							**65.1**	**−0.1**										**35**	**0.44**	**−0.1**										**2.9**		
Reno	4,532	74	81	25.44	29.90	+.04	61.8	+0.8	98	27	77	31	2	47	42	48	36	48	1.12	+0.8	5	4,981	w.	32	w.	16	19	5	6	3.1	0.0	0.0
Tonopah	6,090	12	20	----	----	----	68.6	----	92	24	81	30	10	56	32	48	27	25	0.04	----	1	----	nw.	----	----	----	----	----	----	----	----	----
Winnemucca	4,344	18	56	25.58	29.92	+.04	61.6	−1.2	97	28	78	30	2	45	50	49	38	50	0.28	−0.4	4	4,328	sw.	30	nw.	16	16	11	3	3.4	T.	0.0
Modena	5,473	10	43	24.58	29.82	.00	62.9	−0.4	96	25	81	25	2	45	49	43	20	23	0.01	−0.3	1	7,497	sw.	44	sw.	16	19	7	4	2.7	0.0	0.0
Salt Lake City	4,360	163	203	25.57	29.86	+.01	67.4	0.0	99	28	79	40	3	56	37	51	37	37	0.70	−0.1	2	5,090	s.	39	w.	16	17	6	7	3.4	0.0	0.0
Grand Junction	4,602	60	68	25.32	29.82	−.01	71.8	+0.4	101	28	87	45	3	57	37	50	29	25	0.08	−0.3	3	4,708	se.	34	sw.	16	22	7	1	2.0	0.0	0.0
Northern Plateau							**63.0**	**−0.6**										**52**	**1.50**	**+0.3**										**5.0**		
Baker	3,471	48	53	26.42	29.97	+.02	57.4	−1.2	88	27	70	33	2	44	42	48	40	59	1.81	+0.5	10	3,327	se.	24	w.	18	14	3	13	4.8	0.0	0.0
Boise	2,739	78	86	27.10	29.93	+.02	64.0	−1.3	95	28	77	39	3	51	36	52	41	52	1.08	+0.2	9	3,360	w.	17	sw.	6	14	7	9	4.5	0.0	0.0
Lewiston	757	40	48	29.12	29.93	−.01	66.0	−0.6	94	30	79	42	3	53	40	----	----	----	2.24	+0.8	9	2,154	e.	19	w.	25	10	4	16	5.8	0.0	0.0
Pocatello	4,477	60	68	25.43	29.88	+.01	62.6	+0.4	94	28	76	33	3	49	38	48	35	42	1.47	+0.4	6	5,466	se.	36	s.	29	12	12	6	4.2	0.0	0.0
Spokane	1,929	101	110	27.90	29.93	−.01	61.9	−0.9	88	24	73	40	2	51	38	51	41	55	0.82	−0.5	8	4,348	s.	24	sw.	18	8	8	14	6.1	0.0	0.0
Walla Walla	991	57	65	28.87	29.93	−.03	66.3	−0.2	97	24	77	45	3	55	39	54	43	50	1.57	+0.4	8	3,060	s.	22	w.	18	15	7	8	4.4	0.0	0.0
North Pacific Coast Region							**58.6**	**+0.2**										**71**	**2.09**	**+0.5**										**6.2**		
North Head	211	11	56	29.81	30.04	+.05	55.0	+0.2	65	3	58	48	2	52	14	52	50	87	2.60	+0.3	13	9,865	n.	66	s.	18	8	12	10	5.5	0.0	0.0
Port Angeles	29	8	53	----	30.04	----	55.0	----	74	23	62	39	2	48	28	----	----	----	0.85	−0.4	6	3,985	sw.	22	nw.	24	4	9	17	----	0.0	0.0
Seattle	125	215	250	29.86	29.99	−.01	59.2	+0.2	79	24	66	46	2	52	26	----	----	----	1.75	+0.4	12	5,378	s.	38	s.	18	5	8	17	6.9	0.0	0.0
Tacoma	194	172	201	29.82	30.02	−.01	59.3	+0.6	79	23	67	44	2	52	29	53	47	70	1.65	+0.2	10	5,253	w.	37	sw.	18	4	13	13	6.5	0.0	0.0
Tatoosh Island	86	10	53	29.90	30.00	−.02	54.0	+1.0	64	23	57	46	3	51	13	52	50	89	4.43	+1.2	15	6,484	w.	47	w.	18	0	7	23	8.7	0.0	0.0
Yakima	1,076	58	67	28.78	29.92	----	65.5	----	94	24	78	41	19	53	40	52	40	46	0.55	0.0	8	4,254	nw.	31	w.	18	12	8	10	5.0	0.0	0.0
Medford	1,425	4	80	28.46	29.95	----	63.4	----	97	23	79	36	2	48	40	53	48	68	2.54	----	9	----	nw.	20	sw.	3	13	5	12	4.7	0.0	0.0
Portland, Oreg	153	68	106	29.84	30.00	−.04	62.4	0.0	89	23	71	47	19	54	32	55	49	67	2.19	+0.7	11	3,628	nw.	24	sw.	18	7	4	19	6.9	0.0	0.0
Roseburg	510	75	99	29.46	30.00	−.03	61.4	−1.1	92	24	73	38	19	50	41	53	47	68	2.67	+1.6	10	2,663	n.	20	sw.	15	12	5	13	5.0	0.0	0.0
Middle Pacific Coast Region							**65.9**	**+1.5**										**66**	**1.40**	**+1.1**										**3.6**		
Eureka	62	73	80	29.98	30.05	.00	55.6	+1.3	64	23	61	42	2	50	18	52	50	83	2.39	+1.7	8	4,418	n.	23	sw.	17	6	10	14	6.0	0.0	0.0
Red Bluff	330	54	58	29.54	29.89	+.01	74.0	−0.8	107	24	88	46	2	60	40	58	46	47	1.26	+0.8	5	4,019	se.	20	se.	15	16	5	9	3.6	0.0	0.0
Sacramento	69	106	117	29.82	29.89	.00	71.2	+1.8	106	24	85	43	1	57	40	59	52	59	1.02	+0.9	3	4,897	s.	20	sw.	3	23	3	4	1.9	0.0	0.0
San Francisco	155	208	243	29.78	29.95	−.01	63.0	+4.5	95	21	71	50	1	55	33	56	52	75	0.86	+0.7	6	5,132	w.	30	w.	14	16	9	5	3.5	0.0	0.0
San Jose	141	12	110	29.80	29.95	----	65.8	+0.8	101	22	80	40	1	52	43	----	----	----	1.45	+1.3	5	3,837	nw.	18	nw.	21	20	6	4	2.8	0.0	0.0
South Pacific Coast Region							**69.5**	**+0.8**										**62**	**0.14**	**+0.1**										**2.7**		
Fresno	327	89	98	29.54	29.88	+.03	74.6	−1.2	110	24	89	44	1	60	39	58	44	44	0.28	+0.2	4	5,382	nw.	20	nw.	9	23	4	3	1.8	0.0	0.0
Los Angeles	338	159	191	29.56	29.92	+.02	68.6	+2.2	88	19	78	53	8	60	28	59	53	66	0.15	+0.1	1	3,363	sw.	16	sw.	1	21	6	3	2.8	0.0	0.0
San Diego	87	62	70	29.82	29.91	−.01	65.2	+1.3	86	19	71	54	2	59	23	60	57	77	T.	0.0	0	4,140	w.	22	s.	21	15	10	5	3.6	0.0	0.0
West Indies																																
San Juan, P. R	82	9	54	29.93	30.02	----	79.1	−0.6	88	21	84	71	30	74	13				5.50	−0.3	19	8,739	e.	31	e.	13	6	19	5	5.5	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	[1] 29.74	[1] 29.84	+.02	79.6	−0.5	90	19	85	72	2	74	16	----	----	[2] 88	9.34	+1.2	23	3,431	s.	19	nw.	30	0	4	26	8.6	0.0	0.0
Cristobal	38	7	97	[1] 29.81	[1] 29.84	+.01	81.2	+0.8	91	8	87	73	2	76	16	76	75	[2] 84	18.96	+5.1	22	4,153	se.	23	s.	23	2	5	23	8.2	0.0	0.0
Alaska																																
Juneau	80	11	50	[1] 29.81	[1] 29.90	----	54.2	----	74	15	62	40	15	47	34	50	46	78	4.15	----	18	4,048	se.	19	ne.	15	5	7	18	7.1	0.0	0.0
Hawaiian Islands																																
Honolulu	38	86	100	[1] 30.00	[1] 30.04	----	77.3	----	84	19	82	71	8	73	12	69	65	67	0.27	−0.6	9	5,964	e.	24	e.	14	13	12	5	4.7	0.0	0.0

[1] Pressure not reduced to mean of 24 hours.

[2] Observations taken bihourly.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, June, 1929*

Station	Altitude above mean sea level Jan. 1, 1919	Pressure: Station reduced to mean of 24 hours	Pressure: Sea level reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Mean maximum	Temperature of the air: Mean minimum	Temperature of the air: Highest	Temperature of the air: Lowest	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Total snowfall
	Feet	*Inches*	*Inches*	*Inches*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	*Inches*	*Inches*	*Inches*
Cape Race, N. F.	99				47.2		55.0	39.4	77	34	2.10		0.0
Sydney, C. B. I.	48	29.86	29.91	−0.04	56.4	+1.0	66.7	46.0	84	34	1.02	−2.21	0.0
Halifax, N. S.	88	29.83	29.93	−.02	58.3	+0.6	67.6	48.9	85	40	1.57	−2.19	0.0
Yarmouth, N. S.	65	29.80	29.87	−.08	56.3	+1.3	64.4	48.2	74	40	1.37	−1.56	0.0
Charlottetown, P. E. I.	38	29.79	29.83	−.09	58.5	+1.1	66.0	50.9	81	40	1.33	−1.34	0.0
Chatham, N. B.	28	29.76	29.79	−.10	59.3	−0.7	70.2	48.4	87	33	2.94	−0.52	0.0
Father Point, Que.	20												
Quebec, Que.	296	29.56	29.88	−.04	61.3	+0.1	70.5	52.1	86	39	4.18	+0.53	0.0
Doucet, Que.	1,236				55.8		68.3	43.3	88	25	3.58		0.0
Montreal, Que.	187	29.66	29.86	−.08	64.9	0.0	73.8	55.9	88	38	5.75	+2.22	0.0
Ottawa, Ont.	236	29.63	29.89	−.05	64.8	−0.5	75.8	53.7	94	37	3.76	+0.84	0.0
Kingston, Ont.	285	29.62	29.93	−.04	62.0	−1.4	69.0	55.1	81	40	1.24	−1.19	0.0
Toronto, Ont.	379	29.53	29.93	−.04	63.8	+0.4	74.2	53.4	92	37	1.45	−1.35	0.0
Cochrane, Ont.	930				56.2		67.8	44.6	89	28	3.42		1.2
White River, Ont.	1,244	28.61	29.92	−.02	53.3	−5.4	67.7	38.8	87	27	1.58	−0.64	T.
London, Ont.	808												
Southampton, Ont.	656	29.24	29.95	−.02	57.6	−2.8	67.0	48.1	87	34	1.79	−0.56	0.0
Parry Sound, Ont.	688	29.25	29.93	−.03	59.0	−2.7	68.2	49.9	87	32	2.31	−0.11	0.0
Port Arthur, Ont.	644	29.23	29.94	.00	55.1	−1.3	65.4	44.8	84	31	1.69	−1.04	0.0
Winnipeg, Man.	760												
Minnedosa, Man.	1,690	28.08	29.87	−.02	57.8	−1.8	70.7	44.8	88	26	1.39	−1.61	0.0
Le Pas, Man.	860				57.7		69.9	45.5	81	32	1.19		0.0
Qu'Appelle, Sask.	2,115	27.62	29.83	−.04	58.6	−1.3	70.5	46.7	88	33	1.16	−2.26	0.0
Moose Jaw, Sask.	1,759				62.0		75.9	48.2	92	37	1.31		0.0
Swift Current, Sask.	2,392	27.33	29.80	−.07	61.1	+1.1	75.1	47.1	87	33	3.07	+0.40	0.0
Medicine Hat, Alb.	2,144												
Calgary, Alb.	3,428												
Banff, Alb.	4,521												
Prince Albert, Sask.	1,450	28.28	29.83	−.04	60.2	+2.5	72.4	48.1	89	35	2.46	−0.05	0.0
Battleford, Sask.	1,592	28.10	29.81	−.05	60.6	+1.1	72.8	48.4	88	40	3.75	+0.44	0.0
Edmonton, Alb.	2,150												
Kamloops, B. C.	1,262												
Victoria, B. C.	230	29.73	29.98	−.03	56.8	+0.5	63.8	49.8	76	44	0.99	−0.21	0.0
Barkerville, B. C.	4,180												
Estevan Point, B. C.	20												
Prince Rupert, B. C.	170												
Hamilton, Ber.	151												

LATE REPORTS FOR MAY, 1929

Station	Altitude	Station pressure	Sea level pressure	Departure	Mean	Departure	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure	Total snowfall
Winnipeg, Man.	760	29.19	30.03	+.07	47.7	−3.9	59.0	36.4	83	22	2.69	+0.41	0.2
Medicine Hat, Alb.	2,144	27.65	29.90	+.01	52.6	−1.5	65.6	39.7	88	22	0.74	−0.57	2.2
Calgary, Alb.	3,428	26.40	29.96	+.08	48.6	−0.4	61.8	35.5	80	18	1.90	+0.22	4.0
Banff, Alb.	4,521	25.38	29.96	+.08	44.3	−2.7	56.9	31.7	78	21	1.16	−0.88	5.9
Edmonton, Alb.	2,150	27.65	29.92	+.04	49.8	−1.0	62.3	37.4	78	22	0.65	−0.90	0.0
Kamloops, B. C.	1,262	28.69	29.97	+.08	57.7	−1.4	69.4	46.1	85	36	0.70	−0.54	0.0
Barkerville, B. C.	4,180	25.69	30.00	+.16	42.9	−2.6	54.4	31.5	69	24	2.55	+0.03	7.2
Estevan Point, B. C.	20				47.6		54.7	40.5	57	36	2.24		0.0
Prince Rupert, B. C.	170				48.3		55.5	41.1	61	32	3.76		0.0

Chart I. Departure (°F.) of the Mean Temperature from the Normal, June, 1929

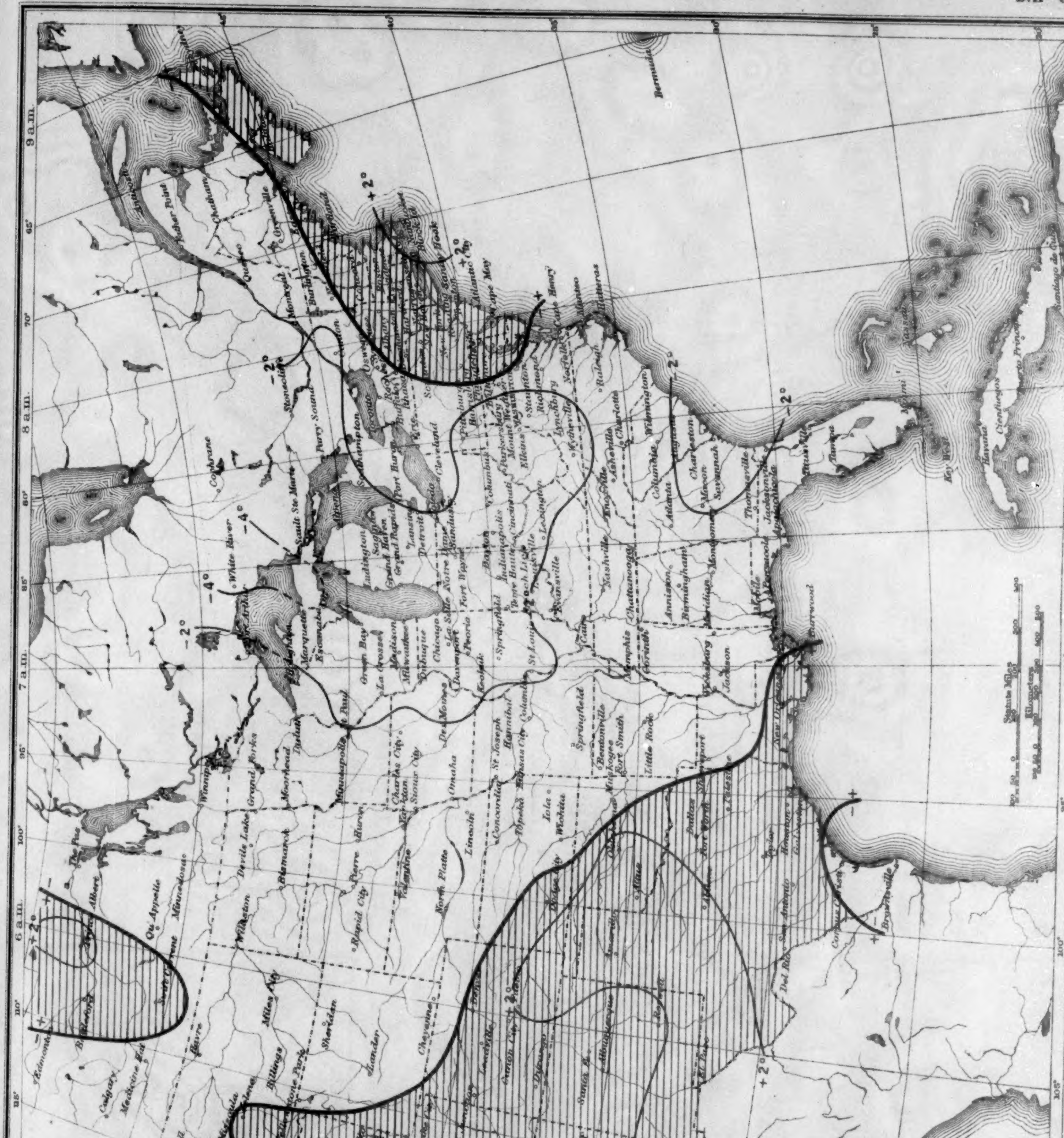

Chart I. Departure (°F.) of the Mean Temperature from the Normal, June, 1929

Shaded portions show excess (+).
Unshaded portions show deficiency (−).
Lines show amount of excess or deficiency.

Chart II. Tracks of Centers of Anticyclones, June, 1929. (Inset) Departure of Monthly Mean Pressure from Normal
(Plotted by Wilfred P. Day)

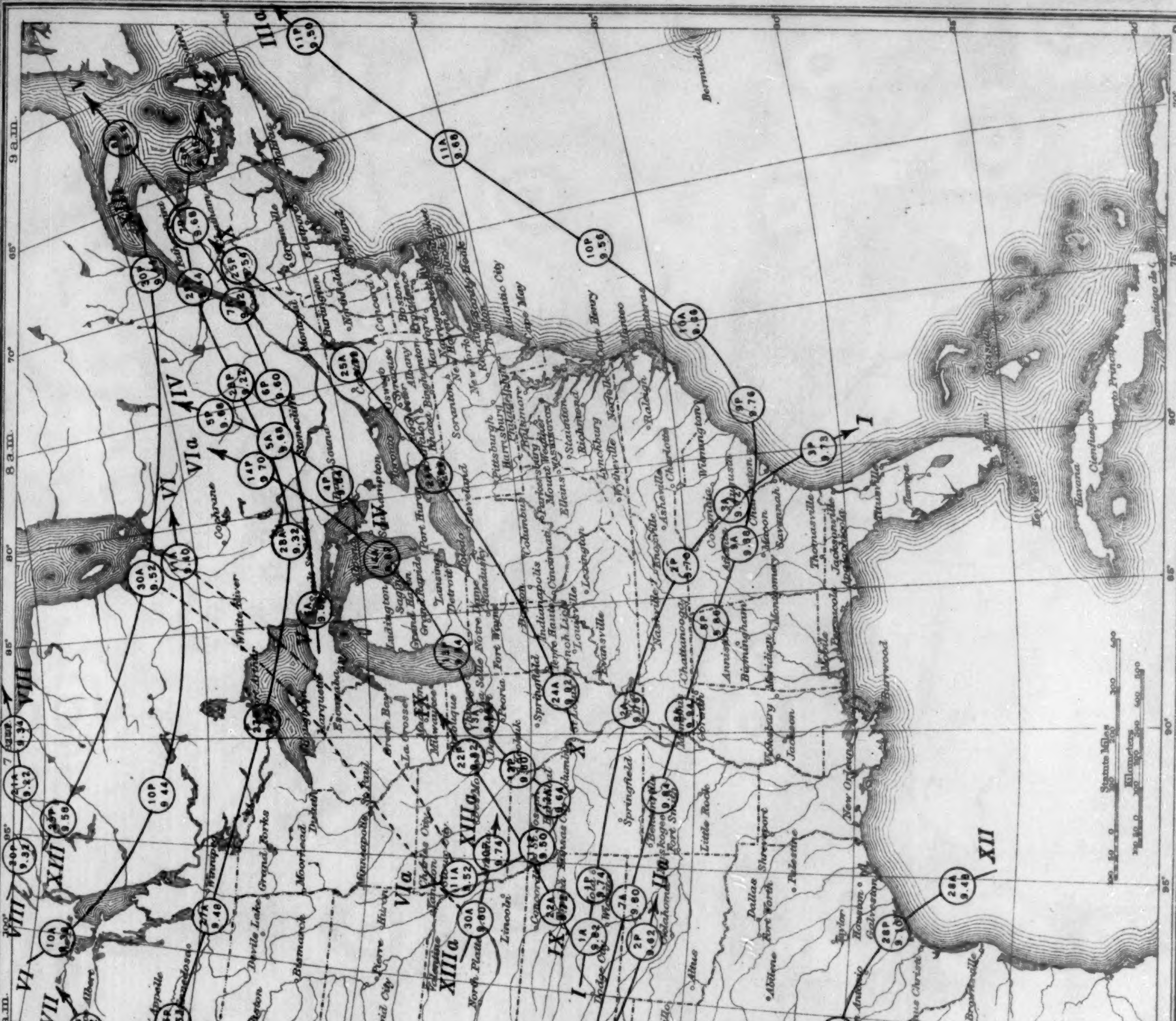

Chart III. Tracks of Centers of Cyclones, June, 1929. (Inset) Change in Mean Pressure from Preceding Month
(Plotted by Wilfred P. Day)

Chart IV. Percentage of Clear Sky between Sunrise and Sunset, June, 1929

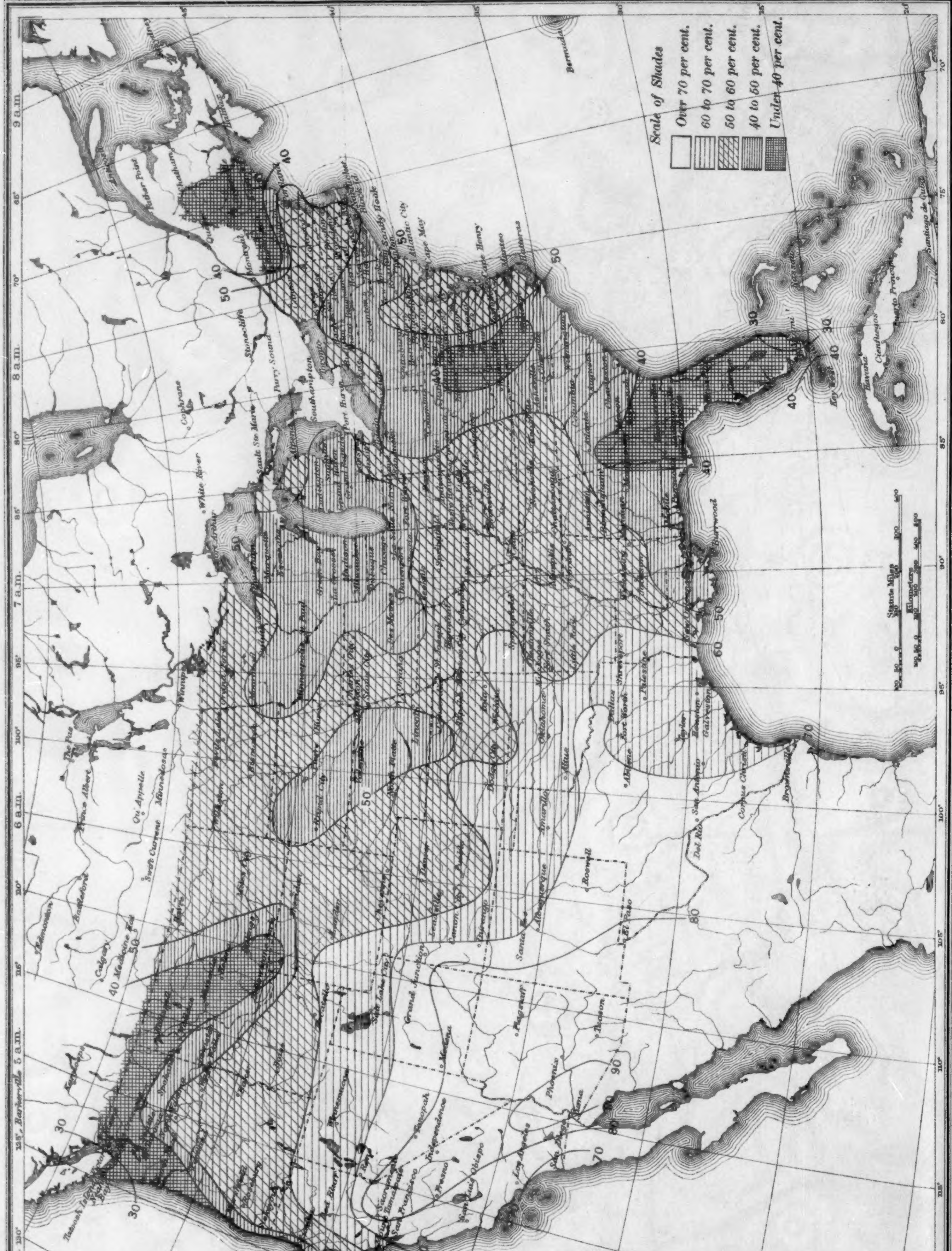

Chart V. Total Precipitation, Inches, June, 1929. (Inset) Departure of Precipitation from Normal

Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, June, 1929

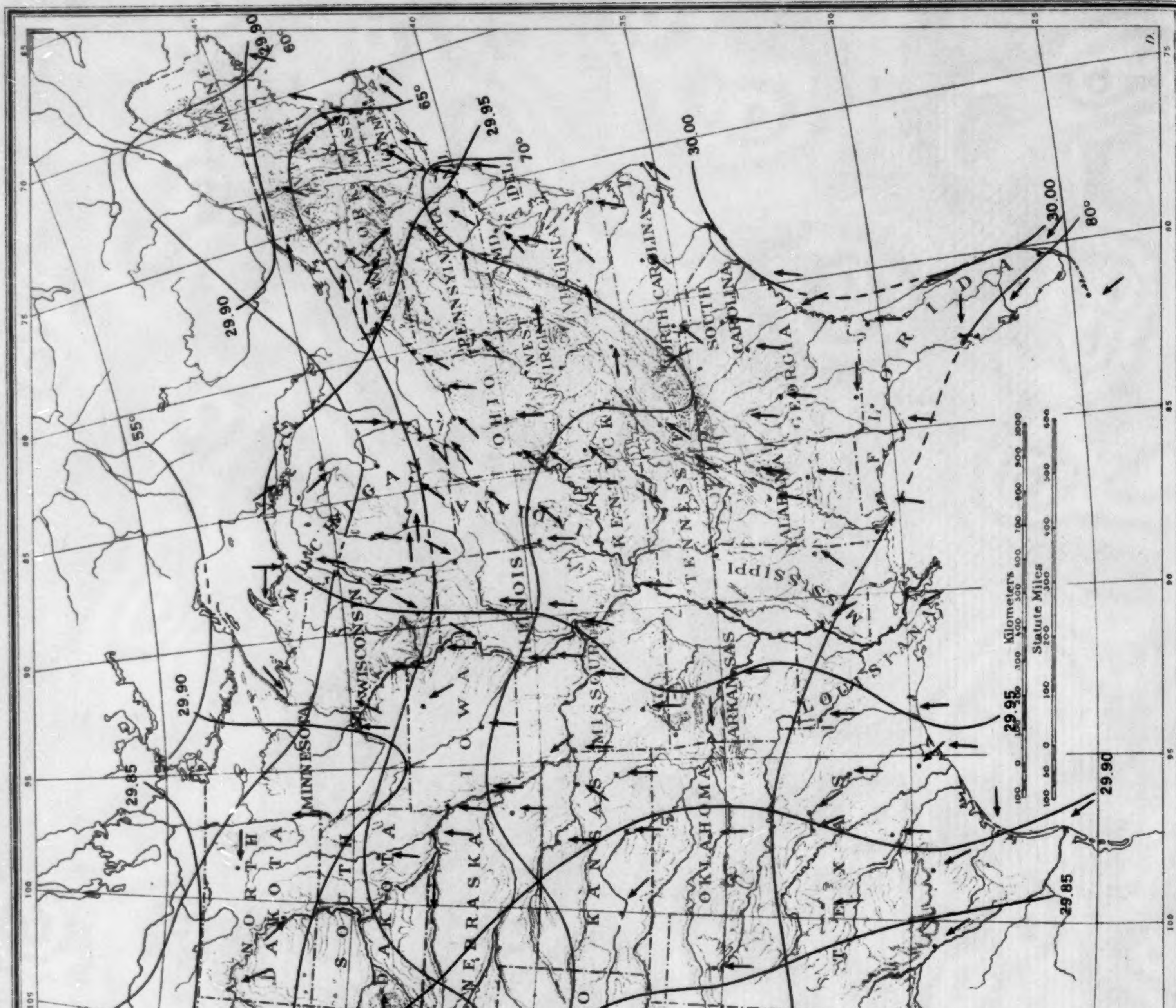

Chart VIII. Weather Map of North Atlantic Ocean, June 12, 1929
(Plotted by F. A. Young)

Chart VIII. Weather Map of North Atlantic Ocean, June 12, 1929
(Plotted by F. A. Young)

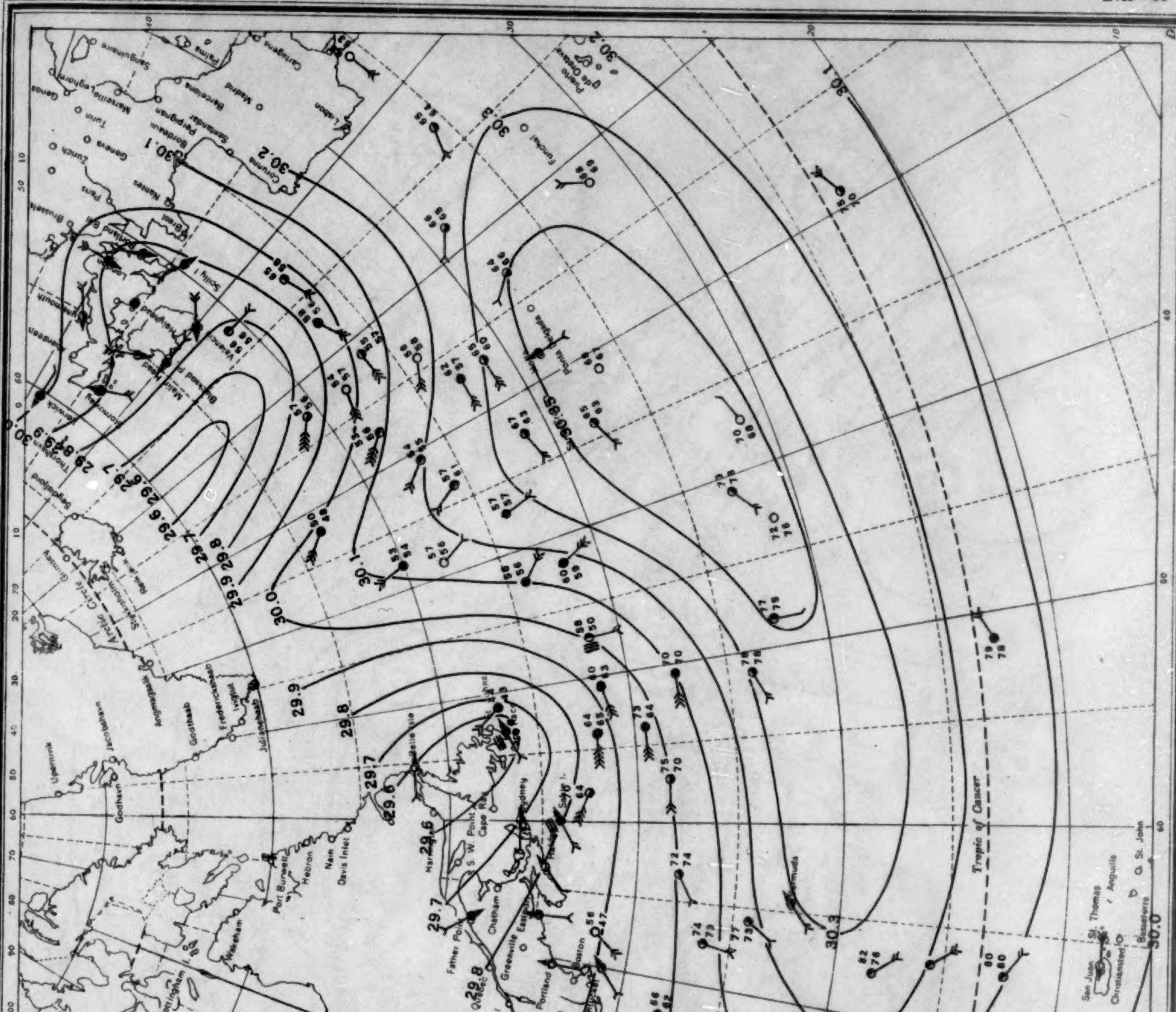

Chart IX. Weather Map of North Atlantic Ocean, June 13, 1929

(Plotted by F. A. Young)

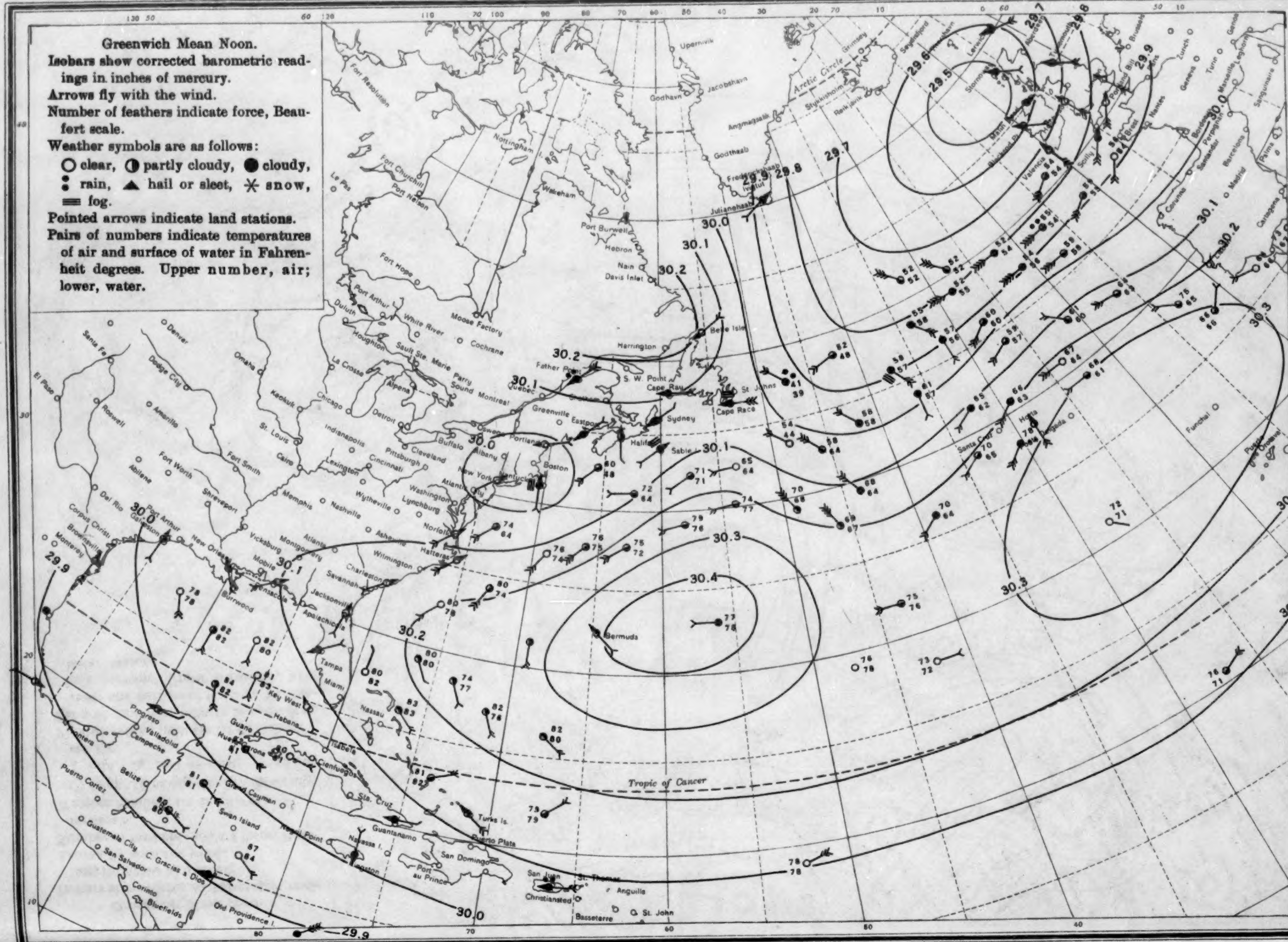

Chart X. Weather Map of North Atlantic Ocean, June 14, 1929
(Plotted by F. A. Young)

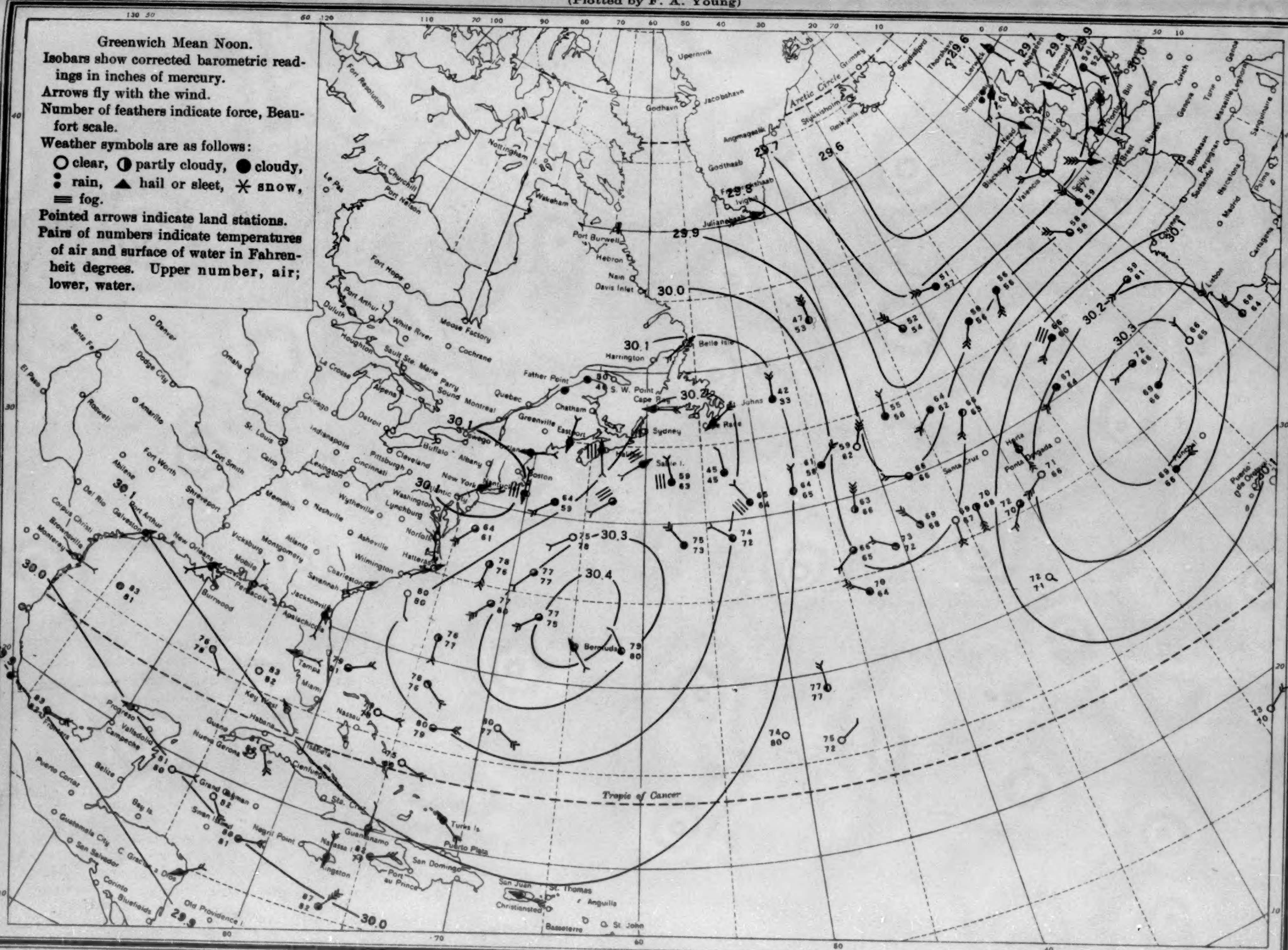

Chart XI. Weather Map of North Atlantic Ocean, June 15, 1929

(Plotted by F. A. Young)